



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

12 JAN 2018

CESAJ-PD

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, South Atlantic Division (CESAD-PDP) 60 Forsyth Street, Room 10M15, Atlanta, GA 30303

SUBJECT: Final Revised Integrated Feasibility Study and Environmental Assessment for the Lake Worth Lagoon Continuing Authorities Program (CAP) Section 1135

1. This memorandum transmits the Final Lake Worth Lagoon CAP 1135 Feasibility Report and Environmental Assessment.
2. We appreciate the consistent support from the SAD technical staff in preparation of this submittal. Questions may be directed to Mr. Dan Vogler, Planning Technical Lead, at 904-232-3634.
3. POC for this memorandum is Dan Vogler, Planning Technical Lead, at (904) 232-3634

A handwritten signature in black ink, appearing to read "Eric P. Summa", followed by the text "(for Eric Summa)" in parentheses.

Encl

ERIC P. SUMMA
Chief, Planning and Policy Division

January 2018

Lake Worth Lagoon CAP 1135

BackCheck Comments from SAD with SAJ responses

Lee Danley Comments

Inconsistent Costs

Concern: Costs shown in the report are inconsistent throughout the report. This includes inconsistencies in cost share between the report and TPCS and project costs shown in the report and executive summary.

Basis of concern: CECW-P Memo on Civil Works Cost Definitions and Applicability dated 25 August 2011 gives clear guidance on the use of constant dollar costs or Project First Cost.

Significance of Concern: Medium

Action Needed to Resolve Concern: Project costs in the report need to be modified to reflect the Project First Cost in accordance with the CECW-P Memo. Additionally, project cost share and Federal participation estimates shown on the TPCS should be consistent with the report.

SAJ Response: Cost updated their TCPS table in the Cost Appendix and got it recertified by MCX back in November. The main report will be updated to match the recertified TCPS. "It is noted that once identified as the Recommended Plan, Alternative 1B costs were further refined based on reduction of material due to mangrove and seagrass after Agency Technical Review. As certified costs of the Recommended Plan were refined through District Quality Control and South Atlantic Division Review, a sensitivity analysis was performed to verify that the costs didn't increase enough to warrant reformulation of the CE/ICA in the report. Costs increased 2%, which maintains Alternative 1B as the "Best Buy" and NER plan. The certified costs of the Recommended Plan is approximately \$11,973,000 (Table 4-2)."

We will also delete the certified costs from the CE/ICA table 3-6.

Project Cost Assumptions

Concern: Some of the detail shown in the Cost Appendix presents information that should be considered sensitive and should be protected from public disclosure.

Basis of Concern: ER 1110-2-1302 Chapter 22 Cost Product Report Submittals describes the level of data required for publicly released reports. Release of sensitive data damages the Government's ability to protect the integrity of the cost product.

Significance of Concern: High

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Action Needed to Resolve Concern: Revise the assumptions listed in the cost appendix to be more general in nature and remove the risk register from the appendix. The risk register can be submitted separately to the SAD Cost Engineer.

SAJ Response: The risk register was removed prior to the November re-submittal. The assumptions paragraph will be revised to remove the quantities and hours.

VE Certification

Concern: The VE Certification is inaccurate.

Basis of Concern: The certification states that VE activities were not conducted in the feasibility phase because the project being is below \$10 M. The fully funded cost of the project is \$12.3 M.

Significance of Concern: Low

Action Needed to Resolve Concern: Based on the April 27, 2017 Memo Implementation Guidance for Section 1004 of the Water Resources Reform and Development Act (WRRDA) of 2014, VE activities are no longer required during feasibility phase. Therefore remove the statement from the certification.

SAJ Response: The referenced statement will be removed from the Value Management Plan.

Editorial Comments:

- The alternatives listed in table 1a of the cost appendix appear to be wrong e.g. there are three alternatives labeled 1A.

SAJ Response: Table 1 will be updated with the correct Alternative names: Alt 2A - EL CID, and Alt 2B - Bonefish

- Cost appendix construction sequence has a typo in item 6. I believe this is supposed to be initiate not imitate.

SAJ Response: Typo will be corrected with "initiate"

- The statement in section 4 of the cost estimate "The contingency was developed using a condensed format since the total project cost is below the threshold for completing a Cost and Schedule Risk Analysis" doesn't seem correct, the threshold described is for Formal CSRA using the more robust Monte Carlo analysis.

SAJ Response: The statement will be updated. Maybe change "condensed" to "Abbreviated". We agree to change the general statement to the following: "The contingency was developed using an abbreviated format since the total project cost is below the threshold for completing a formal Cost and Schedule Risk Analysis."

Barbara Alterra Comments:

Main Report

1. Page 3-19, Sec 3.5.8.21, Cumulative Impacts:

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-- In the 2nd paragraph, the cite should be Section 1501.22, not Part. But is this paragraph needed? It is confusing to address the uncertainties in the EA analysis with a statement about an EIS, and all of the text can be deleted anyway.

SAJ Response: "part" changed to "section"

I removed the mention of the EIS, but I respectfully disagree with removing all of the text. I think the paragraph is helpful since this is a public document. The paragraph provides the regulations that give us the right to make decisions without having all the answers so long as we acknowledge that we don't have all the answers. That said, maybe this text is better suited somewhere else in the document? (e.g. a section talking about uncertainty and risk??)

-- In the 4th paragraph, the second sentence does not make sense and appears to be two separate sentences combined unintentionally. Also, what is the basis for weighing long-term benefits against short-term adverse effects?

SAJ Response:

- a) Sentence changed to read "In addition to the projects and prior studies discussed in section 1.5, the general public ~~and~~ AS WELL AS THE state and local governments could have permitted activities in or around the project area."*
- b) A minor change was made in the second to last sentence to clarify that the long-term benefits outweigh the environmental effects associated with construction. The basis for weighing the long-term benefits against short-term adverse effects is to acknowledge that although construction of the project will result in immediate adverse effects, those effects are short-term and outweighed by the completed project's effects, which are long-term benefits to the environment.*

2. Page 4-6: The previous SAD OC comment was not addressed, which is the following: "Delete the bullet for study team participation and input because the rules no longer allow these costs to be credited toward the NFS share and, therefore, it cannot be WIK."

The PDT appeared to have concurred with the comment in its response, so it may be an oversight that it was not deleted. However, if SAJ concluded the comment was incorrect, please provide the basis for concluding that study team participation and input costs are creditable as work in-kind.

SAJ Response: Bulleted item was deleted

3. The FONSI still needs some cleanup.

- First para: Date of the report is Dec17, not Jul 17. Insert "Section" before 1135.
- In subpara a: Insert "or designated critical habitat" after "listed species" in the 2nd sentence.
- In the last bullet on the second page, how is adherence to the state's WQC requirements a measure?

SAJ Response: updated date, added section

Inserted "or designated critical habitat"

WQC requirements are included as a measure because the conditions/requirements will limit the amount of turbidity that can be in the water, which protects nearby resources, such as SAV.

January 2018

Dan Haubner comments:

Errata Sheet - This is provided when it is desired to refrain from having to change a report. Since the report was changed to reflect the comments related to this errata, the errata sheet is not needed. Cover of Report should reflect July 2017 - Revised December 2017 for version control. The Errata still contains errors in that it reflects FY17 Price Levels, when the Unsigned Certified Cost Estimate says it is FY18 Price Levels.

SAJ Response: Concur regarding errata sheet vs need for full report. Cover of report will be adjusted to reflect Revision date

The RE costs are now consistent, but it still appears that the District is applying "Cost Share" to the RE costs instead of estimating the Sponsor's efforts to obtain the necessary LERRDs and showing that amount as a credit. For this report, every dollar the sponsor spends on preparing and executing an RE document, it is going to cost the Government \$3 to review and approve the document. Small dollar amounts, but it seems as if the District is missing the concept.

SAJ Response: Concur. The RE Admin costs will be reflected at 100% NF responsibility. The RE Appendix will be updated and the Tables in the main report will be updated to reflect such.

The response states that the report is using FY17 Price Levels throughout the report. The numbers being used are FY18 Price Levels based on the TPCS.

SAJ Response: The report will be updated to reflect FY18 Price Levels.

Still find Table 4-3 cumbersome and citing the incorrect price levels. The only reason this works is the potential misapplication of RE costs and crediting.

SAJ Response: Table 4-3 has been corrected and shows FY18 price levels.

Debby Scerno

Typo - in the answer and in the report "been" should be "being"

SAJ Response: The Typo has been fixed.

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 1135 PROJECT



July 2017
Revised December 2017
Revised January 2018



**US Army Corps
of Engineers** ®
Jacksonville District

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US Army Corps of Engineers
JACKSONVILLE DISTRICT

**FINDING OF NO SIGNIFICANT IMPACT (FONSI)
LAKE WORTH LAGOON
CONTINUING AUTHORITIES PROGRAM
SECTION 1135 PROJECT
PALM BEACH COUNTY, FLORIDA
INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT (IFR/EA)**

The U.S. Army Corps of Engineers, Jacksonville District (Corps), has prepared an environmental assessment in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended, and the White House's Council on Environmental Quality regulations to assess environmental effects of the following actions in the Integrated Feasibility Report and Environmental Assessment (IFR/EA), dated January 2018 for the Lake Worth Lagoon Section 1135 Continuing Authorities Program (CAP) project in Palm Beach County, Florida. The Recommended Plan consists of the following:

- Create approximately 50 acres of an eco-island chain at the Bonefish Cove dredge site in Lake Worth Lagoon
- Eco-island construction will use approximately 345,000 cubic yards of borrow material from Peanut Island Dredged Material Management Area and limestone rock will be installed as riprap to protect the islands from erosion
- Eco-islands will be constructed to 3 substrate levels that will support the following habitats: approximately 11 acres of planted mangrove seedlings, 1 acre of oyster habitat, and 38 acres of submerged aquatic vegetation habitat

In addition to the "no action" alternative, four alternatives were also evaluated, including the Recommended Plan. The final array of alternatives considered were evaluated for their success in meeting the planning objectives, including purpose and need, and the planning constraints, including technical feasibility, environmental acceptability, habitat analysis, and economic feasibility. The Recommended Plan was selected because it produces the greatest amount of habitat units at the lowest cost per habitat unit.

I have reviewed the IFR/EA for the Recommended Plan. Based on the information analyzed in the IFR/EA, which reflects pertinent information obtained from agencies having jurisdiction by law and/or special expertise, I conclude that the Recommended Plan will not significantly affect the quality of the human environment and does not require an Environmental Impact Statement. Reasons for this conclusion are in summary:

- a. The Recommended Plan is in compliance with the Endangered Species Act of 1973, as amended. In a letter dated March 15, 2017, the U.S. Fish and Wildlife Service

concluded with the Corps' determination that the Recommended Plan "may affect, but is not likely to adversely affect" listed species or designated critical habitat under their jurisdiction. In a letter dated August 18, 2017, the National Marine Fisheries Service (NMFS) concurred with the Corps' determination that the Recommended Plan is not likely to adversely affect listed species and/or designated critical habitat under NMFS jurisdiction.

- b. Water quality certification will be obtained from the Florida Department of Environmental Protection during the design and construction phase of the project, prior to initiation of construction. The Corps coordinated a consistency determination pursuant to the Coastal Zone Management Act with the state of Florida. In an email dated, April 10, 2017, the Florida State Clearinghouse responded that "...the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes."
- c. Pursuant to section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, consultation with the Florida State Historic Preservation Officer (SHPO), the Seminole Tribe of Florida, and Miccosukee Tribe of Indians of Florida has been completed. The Corps has determined that the recommended plan will have no effect to historic properties eligible or potentially eligible for the National Register of Historic Places. A comprehensive archaeological survey has been performed within the project footprint. Copies of the archaeological survey report have been provided to the Florida SHPO in advance of project construction, and concurrence on a determination of no effect has been received.
- d. The Corps concluded consultation with NMFS under the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act of 1976. NMFS Habitat Conservation Division provided four conservation recommendations on April 25, 2017 with the Corps providing responses on June 16, 2017, concluding consultation.

All practicable means to avoid and minimize adverse environmental effects have been incorporated into the Recommended Plan. Measures will be in place during construction to eliminate, reduce, or avoid adverse impacts below the threshold of significance to fish and wildlife resources including the following:

- A Protected Species Observer shall be present on the project during all construction activities and shall ensure that if any protected species (marine mammals, sea turtles) enter the buffer area, the project shall cease in-water operations until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.
- Water quality shall be protected by adherence to the state of Florida's water quality certification Requirements.

In view of the above and the attached IFR/EA, and after consideration of public and agency comments received on the project, I conclude that the Recommended Plan would not result

in a significant effect on the quality of the human environment. This Finding of No Significant Impact incorporates by reference all discussions and conclusions contained in the IFR/EA enclosed herewith. A copy of these documents will be made available to the public at the following

website: <http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx>.



for Jason A. Kirk, P.E.
Colonel, U. S. Army
District Commander

23 FEB 18

Date

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**FINAL INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PALM BEACH COUNTY, FLORIDA**

EXECUTIVE SUMMARY

PURPOSE AND NEED

Lake Worth Lagoon (LWL) is currently experiencing habitat losses to its marine ecosystem, including losses of seagrasses, oysters, and other benthic marine features because of the direct freshwater discharges into LWL from the Central and Southern Florida (C&SF) regional water management system. Large freshwater discharges from Canals C-16, C-17, and C-51 (constructed in the 1980s by the U.S. Army Corps of Engineers (USACE) as part of the C&SF regional water management system) are causing sudden shifts in the water column, changing conditions in the lagoon from brackish to low salinity condition. When these discharges occur, they can last for hours or even days, negatively impacting seagrasses, oysters, and other features of the LWL marine ecosystem. Additionally, federal dredging and filling activities associated with the Intracoastal Waterway (IWW), and Palm Beach Harbor Navigation Project (PBHNP) further exacerbates additional losses in seagrass, mangrove, and oyster habitat. Delivery of fine-grained sediments and muck from these activities are gradually covering the natural sands and hardpan bottom of the lagoon floor, negatively affecting benthic habitat by partially or totally covering over oyster beds and other benthic features. Therefore, this report will address the need for a federal project to create sustainable habitats for marine ecosystem flora and fauna within LWL that will address the negative impacts to the lagoon's marine ecosystem caused by the C&SF project. South Atlantic Division (SAD) approved the Federal Interest Determination (FID) for moving forward with the feasibility study on March 25, 2015.

BACKGROUND

The study area is located within LWL in Palm Beach County, Florida (Figure ES-1). The IWW runs the entire length of the lagoon, which is approximately 21 miles long and up to one mile wide and runs parallel to the coast line. Two barrier islands (Palm Beach and Singer Islands) separate LWL from the Atlantic Ocean. Eight causeways and bridges connect the mainland to the barrier islands. Lake Worth Inlet connects the northern part of the lagoon to the Atlantic Ocean, and is the entrance channel to the Port of Palm Beach. South Lake Worth Inlet (also known as Boynton Inlet) connects the southern part of the lagoon to the Atlantic Ocean, and is primarily used by recreational boaters to access the Atlantic Ocean.

AUTHORIZATION

The authority for conducting this feasibility study falls under Section 1135 of the Continuing Authorities Program (CAP), authorized under the Water Resource Developmental Act (WRDA) of 1986, as amended, "Project modifications for the improvement of the environment."

The Continuing Authorities Program (CAP) guiding principle is to deliver quality projects to the customer in minimum time and cost, consistent with current federal laws and policies. CAP projects are of a limited scope and complexity; therefore, larger or more complex or costlier projects should be addressed under specifically authorized programs and not under the CAP authority. Under the USACE's current CAP authority, the Federal project cost limit share for a CAP Section 1135 project is \$10 million dollars.



Figure ES- 1. Map of project location and relevant features.

ALTERNATIVE PLANS AND THE RECOMMENDED PLAN

Introduction

Restoration of Peanut Island in northern LWL addressed detrimental effects of past USACE dredging and filling activities directly within the lagoon by creating sustainable marine ecosystem habitats in and around the Peanut Island area. However, these solutions did not address habitat losses to the marine ecosystem resulting from direct freshwater discharges into LWL coming from the C&SF regional water management system. The purpose of this Section 1135 LWL CAP study is to focus on developing potential ecological solutions that can withstand impacts of the C&SF project freshwater deliveries via canals C-16, C-17 and C-51. Discharges from these canals to the lagoon provide flood damage reduction benefits for the upland urban and agricultural areas within the drainage area. Floodwater

discharges, particularly of which are from S-155 (the flood control structure of C-51) at times have sufficient freshwater volumes that temporarily reduce salinity in the lagoon resulting in potentially negative impacts on the marine ecosystem. In addition, these canal discharges transport fine-grained sediments (muck) and attached nutrients (nitrogen and phosphorous) to the lagoon where they may degrade water clarity, increase sedimentation and exacerbate algae bloom problems. A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project's proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species.

While the Section 1135 LWL CAP project cannot prevent future activities that may continue to cause impacts similar to those observed and discussed in the problems identified above, the Section 1135 LWL CAP project can create a project that is more resilient to the conditions and still has an environmental restoration benefit that is viable and sustainable.

Planning Objectives

The following study objectives were developed based on Lake Worth Lagoon 1135 CAP project problems, opportunities, goals, federal objectives, and state objectives and regulations.

- Maximize sustainable seagrass habitat in project area within 5 years
- Maximize nursery habitat for invertebrates/juvenile fishes in project area within 5 years
- Maximize fish habitat near project area within 5 years
- Maximize recruitment of epifauna/infauna benthic organisms in project area within 5 years
- Maximize bird habitat, including habitat for migratory bird and other wildlife in project area within 5 years

Plan Formulation

Descriptions provided in the following sub-sections detail the alternatives, their performance in terms of benefits and costs, and the methods used for screening out alternatives.

Management Measures

The main goal of the project is to provide a sustainable ecosystem solution for flora and fauna within LWL. In order to meet the project objectives, both structural and non-structural management measures were investigated to satisfy one or multiple project objectives. The following is a list of the structural and non-structural management measures given consideration for meeting this goal:

Non-Structural Measures:

- NS-1: adjust/change water control schedule to reduce flows being discharged through the S-155 structure into LWL
- NS-2: divert freshwater flows into a reservoir to reduce accumulation of muck and minimize negative salinity impacts from freshwater pulses

Structural Measures

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2: placement of sandy dredge material over muck sediments in dredge hole to create seagrass habitat

- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a 1:8 side slope with armoring at toe
- S-3: removal of muck & placement of sandy dredge material over muck sediments in dredge hole to creation of infauna habitat
- S-4: planting mangroves to create mangrove habitat

A preliminary screening of the non-structural management measures removed NS-1 (reduction of freshwater flows from S-155) because it did not meet the constraints of USACE's flood control mission. Additionally, NS-2 (diverting freshwater flows into a reservoir) was dropped from consideration, as diverting freshwater flows to a reservoir large enough to reduce muck accumulation and salinity impacts would have been cost-prohibitive under a limited CAP budget. S-3 was not carried forward because muck removal from the lagoon proved to be too cost prohibitive and no suitable sites for material relocation were found.

Alternative Development

The development of four alternative plans looked at utilizing two site locations (El Cid and Bonefish Cove) to create a marine habitat within LWL (Figure ES-2). The four alternatives developed consist of combined management measures that were carried forward from the initial screening. The section below describes the five alternative plans (including the No Action Alternative) for this project:

- **No Action Alternative:** The No Action Alternative will not implement any management measures or construct any type of project features to improve the marine ecosystem of LWL.
- **Alternative 1A – Creation of islands at the "El Cid" location within LWL:** The intent of this alternative is to create an island chain at El Cid that will promote mangrove growth while helping to establish and sustain oyster reef development around the islands. This alternative is a combination of structural management measures S-1, S-2 modification and S-4. Island construction will use borrow material from the Peanut Island Dredge Material Management Area (DMMA), located 6.0 miles northeast of the project site. In addition to planting mangrove seedlings and placing artificial reef modules (2' x 3'), construction efforts will require the installation of rip rap around the islands to protect them from erosive forces due to wave actions occurring within the lagoon. Placement of borrow material from the DMMA will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds around the islands. This alternative will create ~26 acres of suitable habitat for listed species, fish, birds, seagrasses, and other benthic organisms.
- **Alternative 1B – Creation of islands at the "Bonefish Cove" location within LWL:** The intent of this alternative is to create an island chain at Bonefish Cove that will promote mangrove growth while helping to establish and sustain oyster reef development around the islands. This alternative is a combination of structural management measures S-1, S-2 modification and S-4. Island construction will use borrow material from the Peanut Island Dredge Material Management Area (DMMA), located approximately 11.8 miles northeast of the project site. In addition to planting mangrove seedlings and placing artificial reef modules (2' x 3'), construction efforts will require the installation of rip rap around the islands to protect them from erosive forces due to wave actions occurring within the lagoon. Placement of borrow material from the DMMA will help create the suitable substrate needed for establishing oyster beds and will promote recruitment

of seagrass beds around the islands. This alternative will create ~50.0 acres of suitable habitat for listed species, fish, birds, seagrasses, and other benthic organisms.

- **Alternative 2A – Sand capping at the "El Cid" location within LWL:** The intent of this alternative is to cap existing muck sediments to create suitable oyster reef habitat at El Cid. This alternative is a combination of structural measures management measures S-1, & S-2. Muck sediments will be capped using borrow material from the Peanut Island DMMA to form a flat slope over the project site. Placement of artificial reef modules (4' 10" x 6') on top of the borrow material will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds at the project site. This alternative will create ~25 acres of suitable habitat for listed species, fish, seagrasses, and other benthic organisms.
- **Alternative 2B – Sand capping at the "Bonefish" location within LWL:** The intent of this alternative is to cap existing muck sediments to create suitable oyster reef habitat at Bonefish Cove. This alternative is a combination of structural measures management measures S-1, & S-2. Muck sediments will be capped using borrow material from the Peanut Island DMMA to form a flat slope over the project site. Placement of artificial reef modules (4' 10" x 6') on top of the borrow material will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds at the project site. This alternative will create ~48 acres of suitable habitat for listed species, fish, seagrasses, and other benthic organisms.



Figure ES- 2. Location of alternative sites.

Alternative Comparison

The initial array of alternatives, including the No Action Alternative, were compared using costs, benefits, and a Cost Effectiveness/Incremental Cost Analysis (CE/ICA). The initial array for cost effective analysis were screened based on rough order of magnitude (ROM) for construction costs only (Table ES-1). Alternatives 2A and 2B had high costs associated with project construction and produced very low habitat unit outputs per cost, and were therefore deemed not cost effective and received no further consideration.

Table ES- 1. Cost effective analysis for the initial array of alternatives (construction cost only).

Alternative	Plan Cost (ROM)	Average Annual Cost	Construction Duration	Plan Outputs (Habitat Units)	Cost per Unit Output	Cost Effective (Yes/No)
No Action Plan	0	CRF (i=2.875%, n=50)	N/A	0	0	N/A
Alternative 1A	\$5,900,000	\$223,894	5 months	13.8	\$16,234	Yes
Alternative 2A	\$6,200,000	\$235,278	5.5 months	4.0	\$58,136	No
Alternative 1B	\$10,500,000	\$398,455	9 months	29.2	\$13,644	Yes
Alternative 2B	\$11,200,000	\$425,019	7 months	8.5	\$49,867	No

Note: Sorted from lowest to highest cost

The final array of alternatives for incremental cost analysis (Table ES-2) was based on a micro-computer aided cost estimating system (MCACES)-level cost estimate for construction and non-construction costs. After conducting an incremental cost analysis of the final array of alternatives (including the No Action Alternative), Alternative 1B was determined to be the “Best Buy” plan and the National Environmental Restoration (NER) plan (Table ES-2). Table ES-2 also reflects the updated incremental cost analysis for the cost per plan, which maintains Alternative 1B as the “Best Buy” and NER plan.

Table ES- 2. Incremental cost analysis of the final array of alternatives.

Alternative	Plan Cost (MCACES) Construction and Non-Construction Cost	Average Annual Plan Cost (MCACES Level)	Plan Outputs (Habitat Units)	Incremental Habitat Unit	Incremental cost Per Plan	Incremental Cost per Habitat Unit
No Action Alternative	---	0	0	0	0	0
Alternative 1A	\$9,100,000	\$345,328	13.8	13.8	\$345,328	\$25,039
Alternative 1B	\$13,500,000	\$512,299	29.2	15.4	\$166,972	\$10,834

Recommended Plan Benefits

Alternative 1B (creation of eco-island at Bonefish Cove) – was selected as the Recommended Plan because it produces the greatest amount of habitat units at the lowest cost per habitat unit. The Recommended Plan will create an approximately 50 acre eco-island chain at the Bonefish Cove dredge site in LWL (Figure ES-3). The eco-islands will consist of approximately 345,000 yards of borrow material taken from the Peanut Island DMMA allowing the creation of 11 acres of planted mangrove seedlings and 1 acre of oyster habitat as part of the eco-island chain. The building of the islands on a low slope will provide approximately 38 acres of Submerged Aquatic Vegetation (SAV) habitat that is sustainable in the current and future Lake Worth environment of changing salinities and muck accumulation. These actions will create a complex ecosystem that provides suitable habitat to invertebrates/juvenile fishes, infauna/benthic organisms and migratory birds.

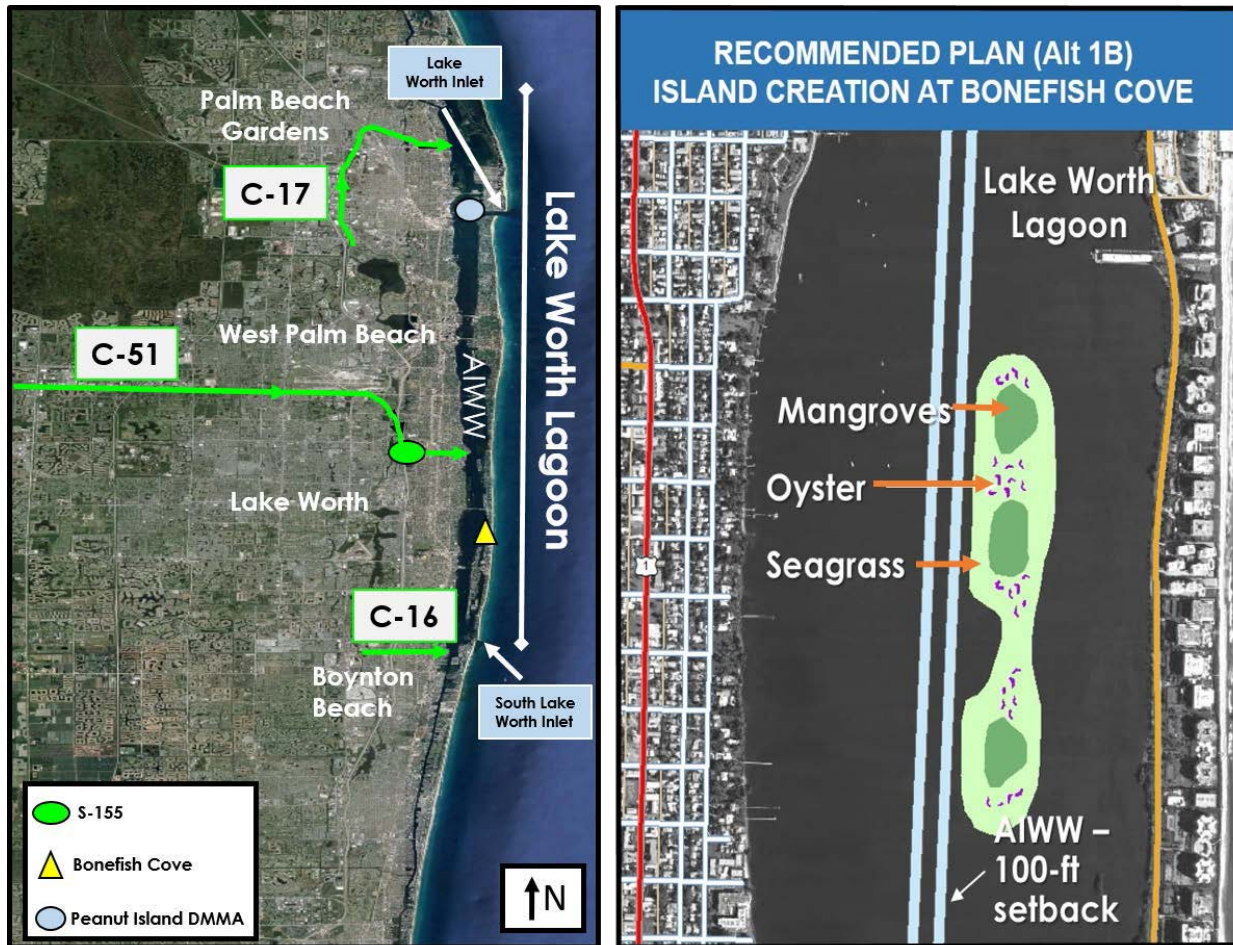


Figure ES- 3. Location and features of the Recommended Plan.

SEA LEVEL CHANGE

Both the project's islands and the Lake Worth Inlet are vulnerable to the effects of sea level rise. Alternative development focused on building sustainable solutions that can adjust to and withstand current conditions, including sea level rise in accordance to USACE guidance (ETL 1100-2-1). In order to recommend an alternative that accounts for the effects of future sea level rise, the planning of this project considered future sea level changes per USACE planning guidance. While sea level rise can reduce the acreage of habitat created by this project, the uncertainty in sea level rise rates will only impact the relatively small habitat acreage of the project. There are no risks to life safety, property, or critical infrastructure due to the project in the event of higher than expected sea level rise rates. The primary strategy for project adaptation to maintain functioning habitat is to add fill to the island's submerged and inter-tidal areas at a rate similar to the rate of sea level rise. Any investigation, design, and construction of such adaptations would be the responsibility of the non-federal sponsor.

ENVIRONMENTAL CONSIDERATIONS

Environmental considerations for this project include species listed as threatened or endangered under the Endangered Species Act (ESA), as well as designated critical habitat, habitats designated as essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, water quality under the Clean Water Act, and historic and cultural resources protected under the National Historic

Preservation Act. A detailed list of all environmental laws, regulations, and executive orders applicable to this action and compliance with those requirements is included in Section 5 of this report.

The expectation is that implementation of the Recommended Plan will provide habitat benefits for several species. Natural recruitment of seagrasses will provide suitable substrate for benthic fauna. Placement of limestone rock and mangroves will provide additional benefits to marine species by reducing muck accumulation. Besides temporary impacts from construction activities, significant negative effects are not anticipated.

COST ESTIMATE AND IMPLEMENTATION

The current cost estimate for the Recommended Plan is \$11,973,000. This cost is more developed than the planning-level costs shown in Table ES-1. Planning-level costs used construction costs only and did not include construction management (Supervision (S&I) or Supervision and Administration (S&A)), engineering during construction, or administrative costs. The certified costs for construction of the Recommended Plan is approximately \$10,359,000 (Table ES-3). Federal costs total 75% of the Recommended Plan, or \$8,979,750. Non-federal costs total 25%, or \$2,993,250. The expected construction duration is 18 months.

Table ES- 3. Refined cost of the Recommended Plan (construction costs only).

CONSTRUCTION COST ONLY Planning Level Estimates 28Oct16				
Alternative 1A*	Item	Number of Units	Units	Cost
	Mangrove	10	ac	\$943,672.00
	Wave Break	3270	lf	\$756,000.00
	Oysters	1	ac	\$67,000.00
	Seagrass	28	ac	\$5,833,328.00
Total =				\$7,600,000
Alternative 1B*	Item	Number of Units	Units	Cost
	Mangrove	10	ac	\$1,551,910.00
	Wave Break	3270	lf	\$954,000
	Oysters	1	ac	\$72,000.00
	Seagrass	28	ac	\$9,122,090.00
Total =				\$11,700,000
Refined Cost Estimate				
Alternative 1B	Item	Number of Units	Units	Cost
	Mangrove	10	ac	\$1,374,037.24
	Wave Break	3270	lf	\$844,656.92
	Oysters	1	ac	\$63,747.69
	Seagrass	28	ac	\$8,077,558.02
				Sub Total =
Non-Construction				\$1,613,000
Total =				\$11,973,000

*No Construction Management (S&I or S&A), EDC, and Administrative (RE)

COORDINATION WITH AGENCIES AND THE PUBLIC

A scoping letter was submitted in October 2016 inviting the participation of all Federal and state agencies, appropriate federally recognized tribes, and interested parties and individuals to provide comments and

identify any issues or concerns. No comments were received. A public notice with links to the draft integrated feasibility report and environmental assessment and associated appendices was posted on the Corps website and available for review and comment from February 24, 2017 through April 25, 2017.

Consultation with the Seminole Tribe of Florida, the Miccosukee Tribe of Indians of Florida, and the State Historic Preservation Officer (SHPO) to comply with Section 106 responsibilities under the National Historic Preservation Act (NHPA) is complete. USACE received confirmation through the public comment process that the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida have no objections to the project at this time. In a letter (DHR No. 2016- 3626-B) dated June 2, 2017, USACE received concurrence from SHPO that the project will have no effect on historic properties eligible for inclusion in the National Registry of Historic Properties (NRHP). (Exact comments received and Corps' responses, can be reviewed in Appendix D-4 (Cultural Resources and Native Americans Resources Consultation) of this report.)

Coordination under Section 7 of the ESA with the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) was initiated on January 20, 2017. A copy of the USFWS Section 7 ESA concurrence letter was received on March 15, 2017. A copy of the NMFS section 7 ESA concurrence letter was received on August 18, 2017. ESA coordination correspondence is included in Appendix D (Environmental). Listed and protected species that may occur in the vicinity of the proposed work include:

- Smalltooth Sawfish (*Pristis pectinata*);
- Johnson's Seagrass (*Halophila johnsonii*);
- West Indian (Florida) Manatee (*Trichechus manatus latirostris*);
- Loggerhead Sea Turtle (*Caretta caretta*);
- Green Sea Turtle (*Chelonia mydas*);
- Hawksbill Sea Turtle (*Eretmochelys imbricata*);
- Leatherback Sea Turtle (*Dermochelys coriacea*);
- Migratory Birds.

USACE has concluded the project may affect, but is not likely to adversely affect (MANLAA) the species listed above and will not affect any designated critical habitat (DCH). This project will be performed in compliance with the state of Florida's water quality standards. An application for a water quality certification will be submitted to the state's Department of Environmental Protection (DEP). This project qualifies for the sovereignty submerged lands management "General Permit to U.S. Army Corps of Engineers for Environmental Restoration or Enhancement Activities" (F.A.C. 62-330.630). In compliance with the Coastal Zone Management Act (CZMA), a Federal Consistency Determination (FCD) is included in Appendix D-2 (CZMA). A copy of the state of Florida's preliminary concurrence with the FCD was received on April 10, 2017 and is included in Appendix D-2 (CZMA).

RESIDUAL RISK

Even with implementation of the Recommended Plan, residual risk remains as a potential issue. Although the Recommended Plan adds sustainable habitat that can withstand current conditions associated with the freshwater discharges coming from the C&SF system, the design of the Recommended Plan does not address current and future events (such as freshwater discharges due to runoff from heavy rainfalls), which could have detrimental effects on achieving benefits obtained in implementing the Recommended

Plan. The design of the Recommended Plan does not prevent the freshwater discharges previously experienced or that will occur in the future in this area. The residual risk associated with overtopping of the Recommended Plan due to sea level rise or extreme high tide events in the future remains as a risk and could threaten the success of the Recommended Plan.

CONCLUSION AND RECOMMENDATION

The Recommended Plan (Alternative 1B: Island Creation at Bonefish Cove) described in this final report provides the optimum solution for ecosystem restoration within the study area that can be developed with the framework of the formulation concepts. Implementation of the Recommended Plan for the Lake Worth Lagoon 1135 Project is recommended at this time, with such modification as the discretion of the Commander, South Atlantic Division, U.S. Army Corps of Engineers (SAD), deems advisable.

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1 INTRODUCTION

1.1 STUDY AUTHORITY

USACE conducted this study under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended – Project Modifications for Improvement of the Environment. Section 1135 projects are part of a larger Continuing Authorities Program (CAP) under which Congress gave the Secretary of the Army, acting through the Chief of Engineers, the authorization to plan, design, and implement certain types of water resources projects without additional project-specific authorization. The Section 1135 authority allows USACE to carry out projects for improving the quality of the environment when it is determined that such modifications are feasible and consistent with the authorized project purpose and will improve the quality of the environment in the public interest. Section 1135 authority addresses environmental degradation associated with an existing USACE project using an ecosystem restoration approach to the extent possible.

USACE carried out this feasibility study in a manner consistent with the USACE Environmental Operating Principles (EOPs). The principles are consistent with the National Environmental Policy Act (NEPA), the Army’s Environmental Strategy with its four pillars (prevention, compliance, restoration, and conservation), and other environmental statutes that govern USACE activities. Finally, the implementation framework proposed as part of the study seeks to work collaboratively, fully engaging individuals, agencies, and local groups in identifying, planning, and implementing ecosystem restoration efforts.

1.2 STUDY SPONSOR

The study was requested by Palm Beach County, the non-federal sponsor, in a letter dated April 1, 2014. Palm Beach County supports the Recommended Plan to implement ecosystem restoration efforts within Lake Worth Lagoon. USACE and Palm Beach County executed a Feasibility Cost Sharing Agreement (FCSA) on October 13, 2015 to conduct this study.

Congressional representation for the area includes the following:

Representative Lois Frankel
2500 N. Military Trail, Suite 490
Boca Raton, FL 33431
(561) 998-9045

1.3 PROJECT AREA

Lake Worth Lagoon is a shallow, “urban” estuarine water body located in Palm Beach County, Florida. The lagoon is approximately 53 miles south of Ft. Pierce Harbor, 40 miles north of Port Everglades, and 65 miles north of Miami Harbor. The ~21 mile long and up to one mile wide lagoon is separated from the Atlantic Ocean by Singer Island and Palm Beach Island; connections to the Atlantic Ocean are at Lake Worth Inlet and South Lake Worth Inlet. Lagoon depths are generally 8 feet (ft) deep, though depths are

greater in certain areas of the lagoon. Lake Worth Lagoon is the largest estuarine system in Palm Beach County and is adjacent to over a dozen watersheds in the Palm Beach and West Palm Beach area. Freshwater discharges feed Lake Worth Lagoon from over six major drainage basins (L-8, STA-1E, C-17, C-51, C-16, and Lake Worth Lagoon basin) spanning over 475 square miles (Figure 2-1). The project area is within the Atlantic Coastal Ridge physiographic region, though the drainage basin of LWL extends into the Sandy Flatlands physiographic area.

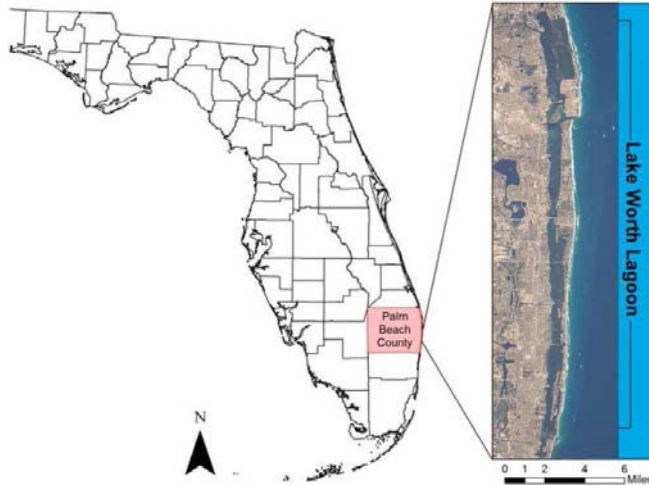


Figure 1- 1. Map of the study area.

1.4 STUDY PURPOSE AND NEED

Freshwater discharges from the C&SF project into Lake Worth Lagoon induce sudden changes in the lagoon’s water column from brackish to low salinity conditions, which can last hours or even days. Rapid salinity fluctuations can have negative impacts on seagrasses, oysters, and other features of the marine ecosystem. Freshwater discharges also deliver fine-grained sediments which gradually cover the natural sands and hard bottom on the lagoon floor, and negatively impact or totally cover oyster beds and other benthic features. A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project’s proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species.

There is a need for a federal project to create sustainable habitat for marine ecosystem flora and fauna within Lake Worth Lagoon that have been negatively affected by freshwater discharges from constructed C&SF projects.

1.5 PROJECTS AND PRIOR STUDIES (BY AGENCY) IN THE VICINITY

1.5.1 L-8 RESEVOIR (SFWMD)

The L-8 Reservoir is a unique, 950-acre former rock mine which utilizes up to 46,000 acre-feet of below-ground storage and will act as Flowage Equalization Basin (FEB) that attenuates flows from local runoff (Figure 1-2). The L-8 Reservoir provides regional water resource benefits, including water supply during drought, flood control during storm events, and surge storage to reduce freshwater inflows to Lake Worth Lagoon. The deep-storage reservoir will function as a multipurpose facility to capture, store, and deliver stormwater runoff to Stormwater Treatment Areas (STA) 1 East and 1 West to improve their treatment performance. The 58-foot deep L-8 FEB is capable of storing 46,000 acre-feet, or 15 billion gallons, of water. The L-8 FEB is able to accept up to 3,000 cubic feet per second (cfs) of stormwater inflows. When the outflow pump station is completed, the pumping station will have the capacity to pump out at a rate of up to 450 cfs of stored water into the C&SF system. Construction of the reservoir and pump station is nearly complete, and the L-8 FEB is now in the process of operational testing. The expected completion date is 2017.

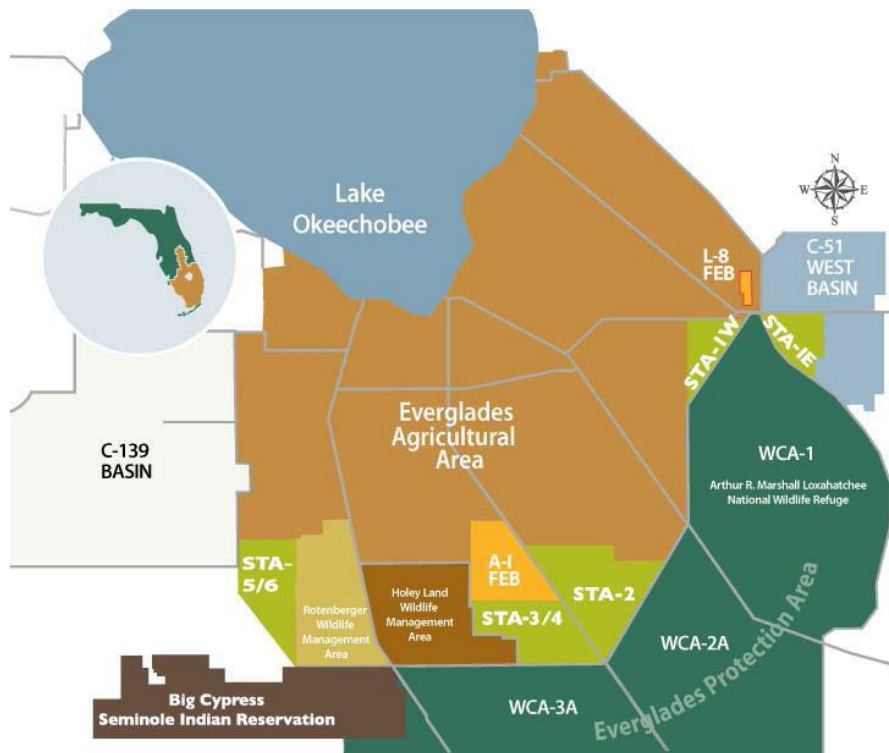


Figure 1- 2. Map of L-8 Flowage Equalization Basin location

1.5.2 C-51 RESEVOIR PHASE I (SFWMD)

The C-51 Reservoir Phase 1 project (Figure 1-3) is a proposed regional alternative water supply project and multi-stakeholder public-private partnership that is critical for future sustainable water supplies in South Florida. It involves the construction of a 14,000 acre-foot in-ground reservoir in central Palm Beach County immediately adjacent to the existing SFWMD L-8 Flow Equalization Basin. The project will provide 14,000 acre-feet of static storage, at 39,000 acre-feet per year of dynamic storage (12.7 billion gallons) and 35 millions of gallons per day for public water supply. The fully permitted project provides an immediate opportunity to address water supply and environmental goals, meeting the urgent need for

additional storage of excess stormwater in the regional system. The project serves to address pressing environmental needs of Lake Worth Lagoon with capture and diversion of excess runoff. The expected completion date is July 2017.



Figure 1- 3. Map of C-51 Phase I Flowage Equalization Basin location.

1.5.3 PEANUT ISLAND (USACE)

Peanut Island was created in 1918 as a result of the creation of Lake Worth Inlet. USACE maintains the Palm Beach Harbor Navigation Project and uses Peanut Island as a Dredge Material Management Area (DMMA) for IWW maintenance, turning basins, jetties, and inlet revetments. Restoration of Peanut Island was conducted in 2005 under the CAP Section 1135 authority. The project restored 26 acres of upland habitats: dune, coastal strand, and maritime hammock, while removing approximately 60 acres of exotic plant species (i.e. Australian Pine, Brazilian Pepper). This project constructed five acres of wetland habitats: a snorkeling reef system and shallow-water lagoon habitat with tidal channels to flush existing mangroves. Native dune plantings on the 12-foot high levee surrounding the Florida Inland Navigation District’s 23-acre DMMA provides slope stabilization and quality wildlife habitat. This project installed over 125,000 native plants and placed 36,000 tons of limestone and granite boulders.

1.5.4 RESTORATION PROJECTS (PALM BEACH COUNTY)

Several projects have been completed to enhance the quality of Lake Worth Lagoon. These projects (Figure 1-4) have achieved a number of goals, including restoration of marine habitat, tidal flow improvements, shoreline protection, and the addition of recreation opportunities. Snook Islands, John’s Island, & Bryant Park Wetlands Restoration are some of the most relevant projects that have been constructed by the local sponsor in the last 20 years. For a detailed description of features added to the lagoon, see Engineering Appendix, Attachment C.

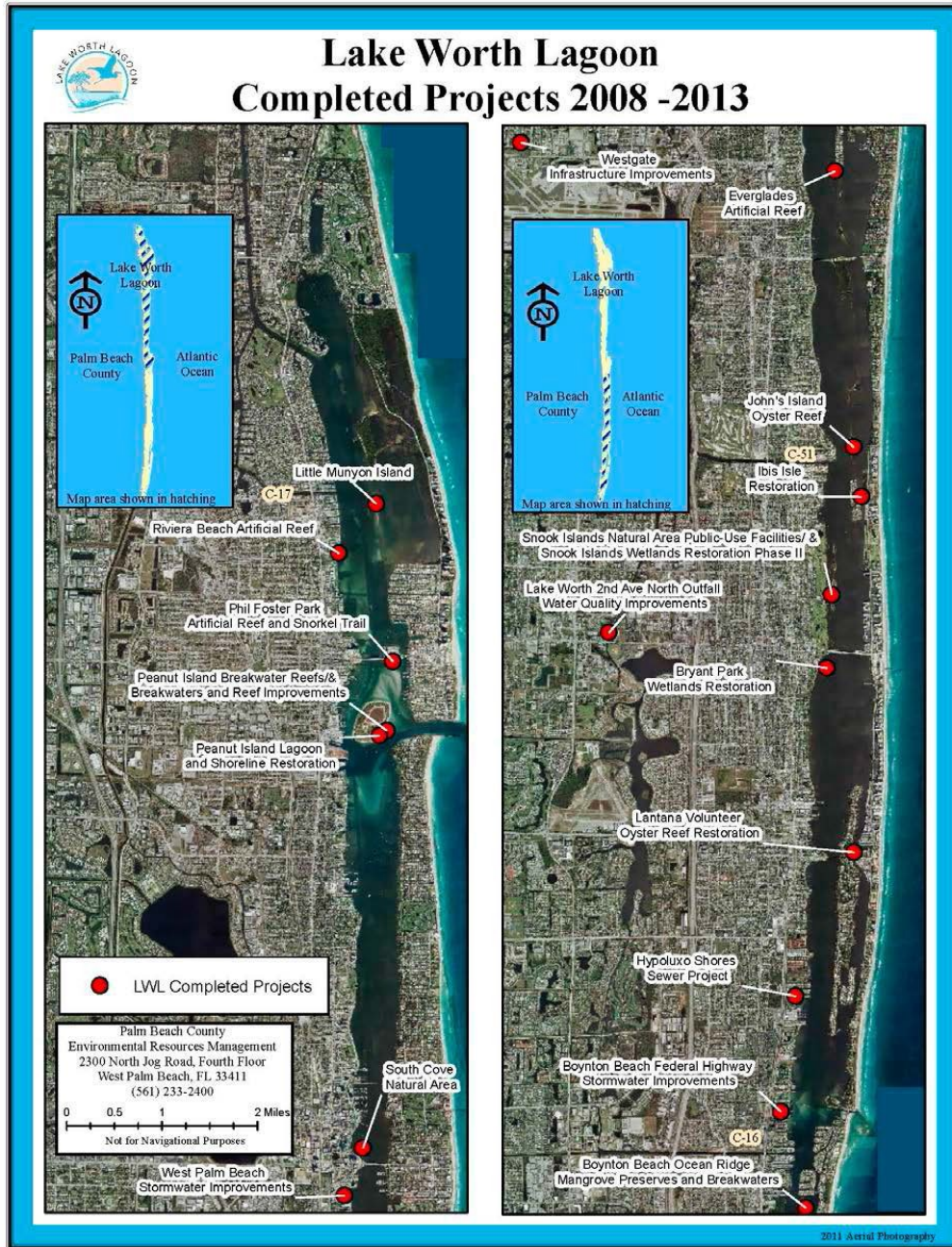


Figure 1- 4. Map of ecosystem enhancement projects within Lake Worth Lagoon.

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2 EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

2.1 GENERAL SETTING

This chapter describes the existing physical, built, natural, and economic environment in the study area within the Lake Worth Lagoon 1135 CAP Project. This chapter provides both the existing conditions (a baseline) as well as a broad forecast of the future conditions, located at the end of each section for each main category (Sections 2.2.5, 2.3.3, 2.4.10, and 2.5.4).

The study area is located within the approximately 21 miles long and up to one mile wide Lake Worth Lagoon in Palm Beach County, Florida. The lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Singer Island and Palm Beach Island. Although once a freshwater body, construction of the Lake Worth and South Lake Worth permanent inlets introduced mixing of fresh and salt waters at the northern and southern ends of the Lagoon. Lake Worth Inlet is 400 ft wide by 35 ft deep and serves as the entrance channel to the Port of Palm Beach, while the 200 ft wide by 6 ft deep South Lake Worth Lagoon is primarily used by recreational boaters (Environmental Applications, Inc., n.d.). In general, Lake Worth Lagoon is a shallow water body with typical depths of 1 ft to 10 ft, though depths are much greater near the Port of Palm Beach and in locations where isolated holes are present from previous dredging activities (Lake Worth Lagoon Initiative, 2013). The IWW traverses the entire length of the lagoon and eight causeways and bridges connect the mainland to the barrier islands.

2.2 PHYSICAL ENVIRONMENT

2.2.1 HYDROLOGY

Historically, drainage patterns of south Florida were characterized by gentle, meandering surface water flows through rivers, creeks, and sloughs and overland sheetflow through contiguous marshy areas. This natural system absorbed floodwater, promoted groundwater recharge, assimilated nutrients, and removed suspended materials (USACE & SFWMD, 2002). The current hydrology of Lake Worth Lagoon is influenced by coastal processes (i.e. waves, tides, and currents), though the dominant influence on the hydrology is surface freshwater input from several flood control structures (described in Section 2-3). A period of analysis from 1987-2016 concluded that S-155, the flood control spillway structure for Canal C-51 located in central LWL, is responsible for approximately 65% of the total volume of freshwater inflow into LWL. For more information on the hydrologic system of LWL, see Engineering Appendix, Section 3.

2.2.1.1 LAKE WORTH LAGOON WATERSHED

Lake Worth Lagoon watershed is approximately 478.5 square miles large and contains a sophisticated network of canal systems. The natural state of the watershed consisted of a well-drained area east of the coastal ridge and poorly-drained lowlands west of the coastal ridge (Taylor Engineering, Inc., 2009), which was often prone to severe flooding. To lessen flooding, the federal C&SF Project and several small-scale drainage projects were implemented, which drained the natural wetland. These drainage projects connected many isolated wetlands and modified many of the natural features of the wetlands into urban and agricultural land. There are several drainage basins in the Lake Worth Lagoon watershed: L-8, STA-1E,

C-17, C-51, C-16, and Lake Worth Lagoon basin (Figure 2-1). For more information on the canals and drainage basins, see Engineering Appendix, Attachment B.

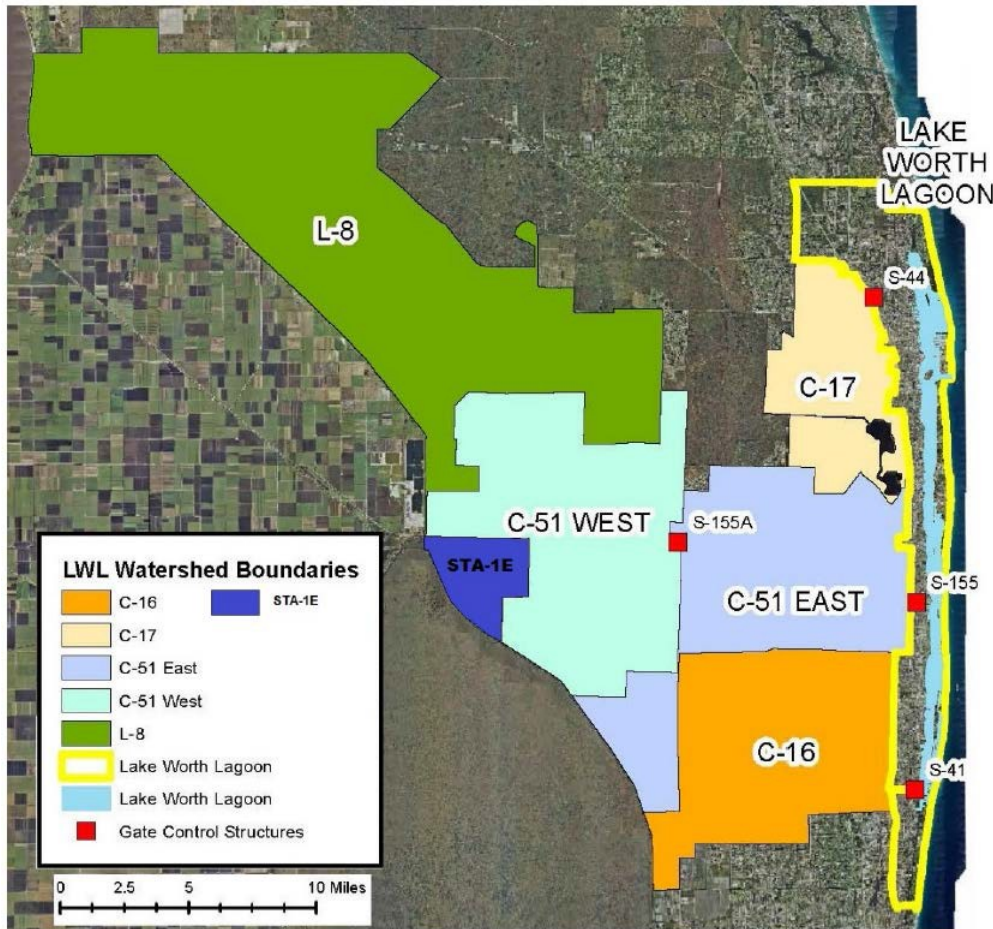


Figure 2- 1. Lake Worth Lagoon Watershed basins.

2.2.2 EROSION AND SEDIMENTATION

Natural sediment in Lake Worth Lagoon is comprised primarily of sand or shell fragments (Sea Diversified, Inc., 2010). However, deposition of fine-grained silt and clay-enriched organic “muck” sediments of greater than 1 ft in depth have been observed in over 42 locations in Lake Worth Lagoon (Lake Worth Lagoon Initiative, 2013). Muck sediments are prone to resuspension, and thus negatively impact photosynthetically-reliant biota by blocking light within the water column and reduce the overall water quality within the lagoon. Muck deposition is particularly concentrated near canal discharge locations, resulting in decreased productivity and in some cases abrupt death to organisms by creating hypoxic and anoxic conditions. Sediments are dispersed over a large portion of the lagoon, accumulating at variable rates between ~ 0.1-0.9 cm/yr, with an average rate of ~0.4-0.5 cm/yr (Trefry, Trocine, & Bennett, 2009)).

2.2.3 CLIMATE

The climate of south Florida is humid subtropical region and is subject to cyclic dual season of meteorology; a wet and dry season. These seasons are defined as May to October for the wet season and

November to April for the dry season. During the wet season, the LWL typically experiences frequent (often daily) brief and sometimes intense rainfall events. Additionally, the watershed is prone to Atlantic tropical cyclonic events, which produce large amounts of rain over a significant area. Several of the major flooding events into the LWL were caused by these tropical events (Table 2-1) and observed through a nearby flood structure, S-155.

Table 2- 1. Maximum flow events through S-155 and named storms.

Date	S-155 Flow (cfs)	Named Storm
16 Jan 1991	4,605.30	N/A
18 Oct 1995	5,364.87	N/A
16 Oct 1999	7,141.80	Hurricane Irene
26 Sep 2004	4,896.06	Hurricane Jeanne
27 Aug 2012	5,057.81	Hurricane Isaac

According to the West Palm Beach International Airport (NOAA gage ID: USW00012844) from the Global Historical Climatology Network Database (GHCN), the average, maximum, and minimum annual water-year (May to April) rainfalls are 61.12, 102.90, and 32.85 inches, respectively, for the period of record 1938-2016. The wet season (May to Oct.) contains the majority of the rainfall averaging 41.97 inches and the dry season averages 19.15 inches (Table 2-2).

Table 2- 2. Rainfall statistics and seasonal allocation at NOAA gauge USW00012844, West Palm Beach International Airport.

Statistic	Dry Season (Nov to April)	Wet Season (May to Oct)	Water Year (May to April)
Percent	31%	69%	100%
Average (in.)	19.15	41.97	61.12
Minimum (in.)	4.06	21.33	32.85
Maximum (in.)	42.56	75.61	102.90

For more information on the climate of Lake Worth Lagoon, see Engineering Appendix, Section 2.3.

2.2.4 SEA LEVEL

The Lake Worth Lagoon project area is located approximately 60 miles from NOS gage #8723170 at Miami Beach, Florida. The historical local sea level rise rate taken from this gage was determined to be 2.39 mm/year (0.00784 ft/year; USACE, 2015). Given a project base year of 2019, a table of sea level change rates was produced for each of the three required scenarios through one hundred years from the project base year (Engineering Appendix, Table 2-8). Figure 2-2 provides a graphic representation of the three levels of projected future sea level change for the 50-year planning horizon of the project (2019 to 2069) as well as an additional 50 years (to 2119). By 2069 relative sea level rise predictions equal 0.39 ft, 0.85 ft, to 2.32 ft for the Baseline, Intermediate, and High SLR curves, respectively. Relative sea level rise projections within the project area by 2119 equal 0.79 ft (Baseline), 2.15 ft (Intermediate), to 6.5 ft (High) (Engineering Appendix, Table 2-8).

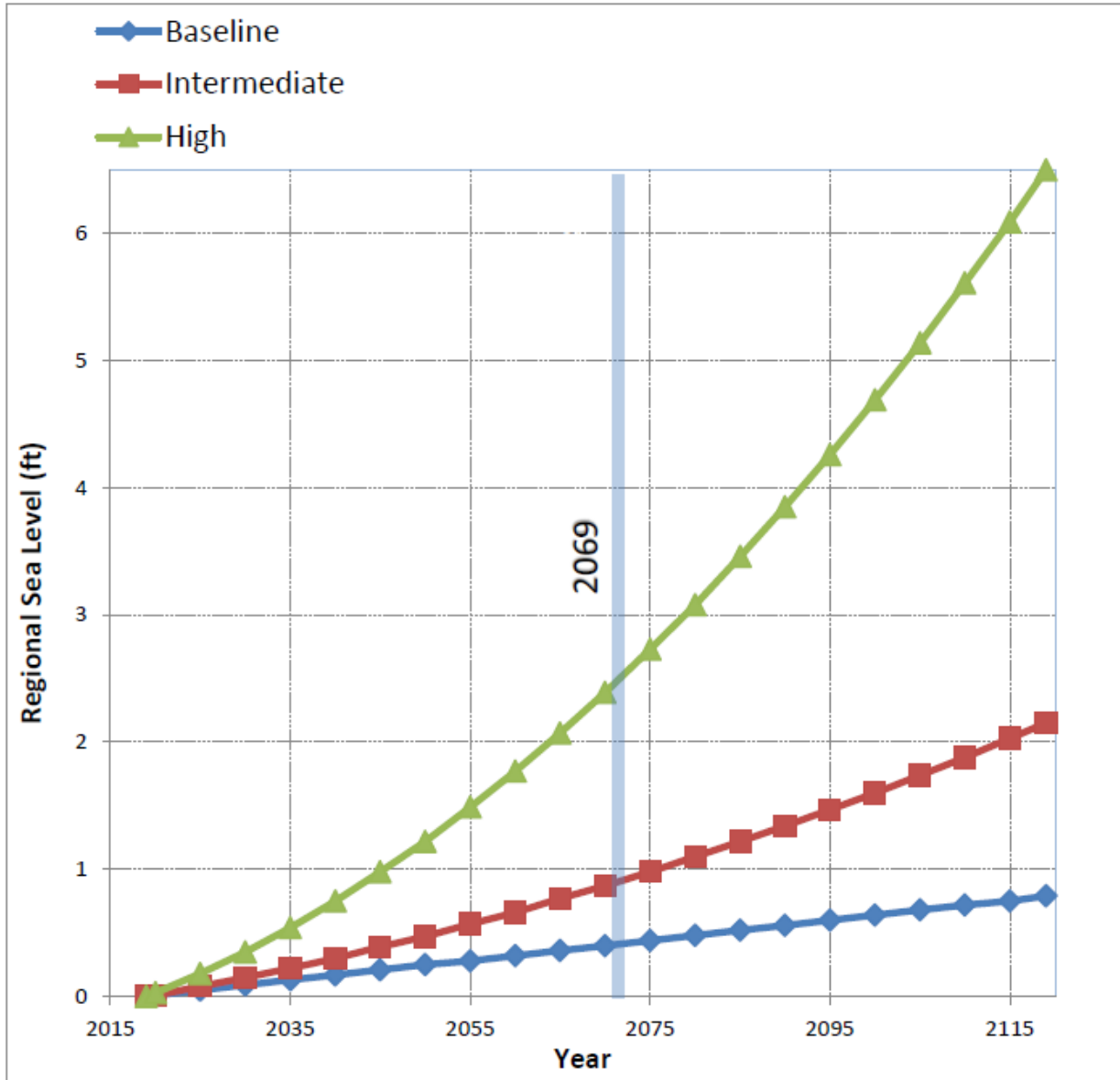


Figure 2- 2. Predicted relative sea level rise in the project area by the year 2069.

2.2.5 FUTURE WITHOUT PROJECT CONDITIONS (NO ACTION ALTERNATIVE) – PHYSICAL ENVIRONMENT

Conditions in the physical environment for the hydrologic system and climate will most likely continue to be the same in the future. Significant land use changes are not expected to occur within the life of the project, and thus the amount of sedimentation will likely continue at the current rate or increase slightly. Sea level is projected to rise at least 0.39 ft within the 50 year project horizon. Although sea level will negatively affect many species with or without project implementation, the species that would benefit from project conditions (i.e. SAV, oysters, benthic fauna, fish) would likely experience decreased productivity and potential mass mortality without completion of this project.

2.3 BUILT ENVIRONMENT

2.3.1 RESIDENTIAL AND COMMERCIAL STRUCTURES

The shoreline of Lake Worth Lagoon is made up of commercial buildings, high-rise condominiums, and residential homes. As much as 81% of the Lake Worth Lagoon shore is armored with seawalls and rip rap, and only ~19% of the shoreline remains lined with mangroves (Figure 2-3).

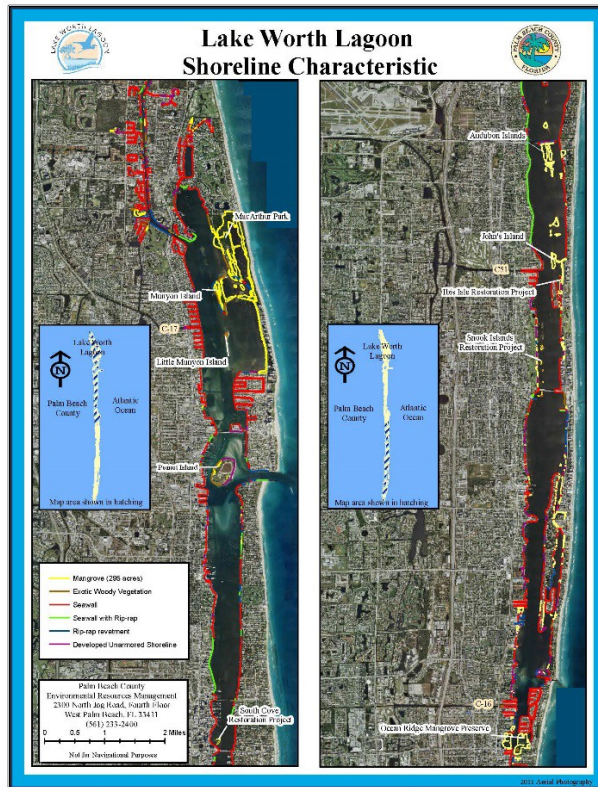


Figure 2- 3. Shoreline characteristic map of Lake Worth Lagoon. From Palm Beach County (2011).

2.3.2 WATERSHED DEVELOPMENT

Modification of the Lake Worth Lagoon watershed for flood control purposes was originally authorized by Congress under the C&SF project in 1948. This, along with smaller-scale drainage projects, significantly altered the quality, quantity, and timing of freshwater flows into Lake Worth Lagoon (Environmental Consulting & Technology, Inc., 2008). More detailed analysis of the watershed development is in Engineering Appendix, Attachment B.

2.3.3 FUTURE WITHOUT PROJECT CONDITIONS (NO ACTION ALTERNATIVE) – BUILT ENVIRONMENT

The built environment is generally expected to increase in the future. Although the western area of the watershed is not expected to convert from agricultural to urban land use, populations in already urban

areas are expected to increase. For example, the population of Palm Beach County is expected to rise to 1.7 million by 2035 (Caprozzi, J., 2013), an increase from 1.4 million (United States Census Bureau) in 2015. While this doesn't necessarily mean significant changes to residential and commercial structures, it is likely that more canals will be needed to accommodate water supply needs. Increased freshwater flows into Lake Worth Lagoon from drainage canals would increase the amount of muck deposition within the lagoon. While this scenario is likely regardless of alternative, the No Action alternative does not provide a solution to help limit muck accretion.

2.4 NATURAL ENVIRONMENT (AFFECTED ENVIRONMENT)

The Affected Environment section succinctly describes the environmental resources of the areas that would be affected if any of the alternatives were implemented. This section only describes those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect, or that would be affected, by the alternatives if they were implemented. This section, in conjunction with the description of the No Action alternative forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

2.4.1 VEGETATION

Submerged aquatic vegetation (SAV) are a valuable component of ecosystems because they provide food, habitat, and shelter for many organisms. In the period 1940 to 2001, sea grass acreage in Lake Worth Lagoon decreased over 60% from 4,271 to 1,626 acres (Braun, 2006). As of 2013, approximately 1,592 acres of seagrass beds were identified within Lake Worth Lagoon, a decrease from 1,688 acres identified in 2007 (Orlando et al., 2016). Multiple species of seagrass have been found in the Lagoon, including the threatened species Johnson's seagrass (*Halophila johnsonii*), which is described in more detail in section 2.4.3.1. Other species of seagrasses present may include manateegrass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), paddle grass (*Halophila decipiens*), and turtlegrass (*Thalassia testudinum*). Most species are found in the northern segment of the lagoon where salinity levels are more stable due to incoming tides through Lake Worth Inlet. The central segment of the lagoon (the location of this project) has only ~12% of seagrass coverage, which is likely due in part to the inability of SAV to cope with rapid salinity fluctuations (Orlando et al., 2016). Freshwater inflows from C-51, along with large storms have led to mass mortality events of salinity-sensitive SAV species within the lagoon. Widespread fine-grained sediment (muck) accumulation is also responsible for negatively affecting SAV, either through burial or by disrupting nutrient levels required for SAV productivity. The majority of sediments enter the lagoon through C-51; as much as 19% of the sediment input is comprised of organic sediments. Additionally, because SAV are sensitive to the amount of light available within the water column, elevated turbidity within Lake Worth Lagoon directly correlates to the abundance and health of SAV (Crigger, D. et al., 2005). A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project's proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable submerged aquatic vegetation habitat.

2.4.2 FISH AND WILDLIFE RESOURCES (OTHER THAN THREATENED AND ENDANGERED SPECIES)

The biological communities in the project area must cope with the incoming canal freshwater flows and fine-grained sediments and muck. Degradation and loss of natural benthic habitats from muck and fine-grained sediments accumulation has likely caused a decline in the numbers of organisms at the base of the food web, which can impact the life cycles, community structures, and population densities of the overall fauna present in the lagoon.

2.4.2.1 OYSTERS

Oysters are vital components of lagoon ecosystems and are ecologically important because they support habitat diversity, help prevent erosion, and improve water quality by filtering suspended solids from the water column (Scarpa & Laramore, 2010). There are approximately seven acres of oyster beds in Lake Worth Lagoon (USACE, 2011), many of which were created through restoration projects. Productivity of oysters is dependent on several factors, including salinity, hydrology, food availability, and substrate type (Scarpa & Laramore, 2010). The optimal salinity range for Eastern oysters (*Crassostrea virginica*) is 14-28 ppt, though they can survive low salinities (~5 ppt) for extended periods as long as temperatures are not high (<25° C) (Shumway, D., 1996). Summer temperatures often exceed 25° C in the project area, which is also the wet season; the combination of high temperatures and increased freshwater discharges from canals have the ability to negatively affect the overall health and survival of oysters (Heilmayer et al., 2008). Significant drops in salinity from excessive freshwater inflows has been proven decrease growth, reproduction, and spat recruitment – significant mass mortality in oysters may occur if negative conditions continue for extended periods of time (Lake Worth Lagoon Initiative, 2013). A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project’s proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable oyster habitat.

2.4.3 THREATENED, ENDANGERED, AND PROTECTED SPECIES

2.4.3.1 JOHNSON’S SEAGRASS

Johnson’s seagrass (*Halophila johnsonii*), the only listed threatened marine plant species under the Endangered Species Act, is found throughout Lake Worth Lagoon. Though Johnson’s seagrass is sensitive to turbidity, dissolved organic matter, and temperature, it is especially vulnerable to salinity fluctuations. Salinities of 30 parts per thousand (ppt) are required for optimal growth, however Johnson’s seagrass is more tolerant of gradual salinity decreases and can survive for several weeks at salinities between 15-20 ppt. At 10 ppt, tolerance of Johnson’s seagrass declines rapidly to the point that 100% mortality is expected within 10 days of exposure below this threshold (Griffin, 2011). Data collected between 2010 to 2016 indicates there is an inverse relationship between freshwater discharge events and salinity levels in central Lake Worth Lagoon, with low salinity events (<10 ppt) occurring on an almost annual basis (see Section 2.4.6 for more information). A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project’s proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species.

2.4.3.2 SEA TURTLES

Within Lake Worth Lagoon, multiple species of turtles have been observed; the green sea turtle (*Chelonia mydas*), the loggerhead (*Caretta caretta*), the leatherback (*Dermochelys coriacea*), the Hawksbill (*Eretmochelys imbricata*), and the Kemp's Ridley (*Lepidochelys kempii*). The lagoon is connected to nesting beaches and serves as an important developmental habitat for juvenile green sea turtles year round, which feed almost entirely on SAV. Because of their diet, green sea turtles concentrate in areas of healthy SAV where salinity levels are more constant. The green sea turtle population in Lake Worth Lagoon have a moderate prevalence of Fibropapillomatosis, which has been reported as stable or slightly increasing within the population (Palm Beach County Department of Environmental Resources Management, 2012).

2.4.3.3 MANATEES

The Florida manatee (*Trichechus manatus latirostris*) has been listed as a protected mammal in Florida since 1893. Federal law, specifically the Marine Mammal Protection Act of 1972 (MMPA) and the Endangered Species Act of 1973 protects manatees. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act, designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways.

Lake Worth Lagoon is recognized as one of the most important manatee refuges on Florida's east coast. Manatees are present year-round in the lagoon, especially during winter months when many migrate to warm water refugia near Florida Power and Light Company's Riviera Beach Next Generation Clean Energy Center.

2.4.3.4. SMALLTOOTH SAWFISH

Smalltooth sawfish, *Pristis pectinata* were once common in Florida as detailed by the "Smalltooth Sawfish Recovery Plan" (NMFS, 2009) and are rarely reported in southeast Florida. Their core range extends along the Everglades coast from the Ten Thousand Islands to Florida Bay, with moderate occurrences in the Florida Keys and at the mouth of the Caloosahatchee River. Outside of these areas, sawfish are rarely encountered and appear to be relatively rare (Simpfendorfer 2006).

2.4.3.5 MIGRATORY BIRDS

Migratory birds may fly through Southeast Florida and use areas in or adjacent to the project footprint and Peanut Island. Common species include ibis, osprey, brown pelican, seagull, snowy egret and great blue heron (Palm Beach County Board of County Commissioners et al., 2011). Birds may be temporarily unable to use portions of Peanut Island during construction. The mangrove island project footprint is currently subtidal, therefore there is limited habitat for migratory birds.

2.4.4 ESSENTIAL FISH HABITAT (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may affect Essential Fish Habitat (EFH). This report with integrated EA is prepared consistent with guidance provided by the NMFS Southeast Regional Office to USACE, Jacksonville District regarding coordinating EFH consultation requirements with NEPA (NMFS 1999a). EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The rules promulgated by the NMFS in 1997 and 2002 further clarify EFH with the following definitions:

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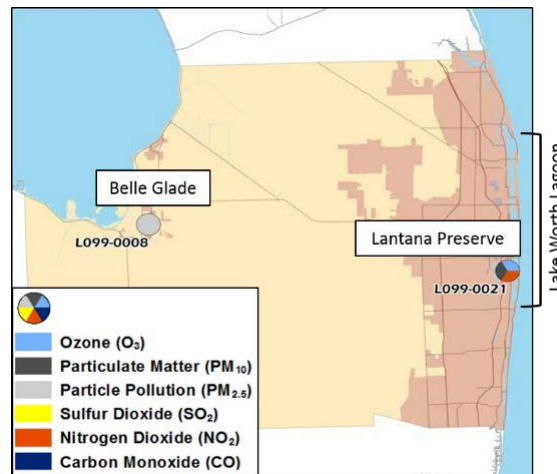
FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

- Waters – aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate;
- Substrate – sediment, hard bottom, structures underlying the waters, and associated biological communities
- Necessary – the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and
- Spawning, breeding, feeding, or growth to maturity – stages representing a species’ full life cycles (50 C.F.R. Part 600; NMFS, 2004).

Over 250 species of fish have been documented in Lake Worth Lagoon (Palm Beach County Department of Environmental Resources Management, 2015). Sand habitats are EFH for a variety of fish. Major components of waters, substrate, necessity, and life stages are present for representation of all stages for fish species life cycles. The entire watered portion of the project area is considered as EFH under the above definition. Corals, coral reefs, seagrasses, and hardbottoms are designated as a Habitat Area of Particular Concern (HAPC), which is a subset of EFH that is either rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. In light of their designation as HAPC and Executive Order 13089, NMFS applies greater scrutiny to projects affecting corals and seagrasses to ensure practicable measures to avoid and minimize adverse effects to these habitats are fully explored. Seagrasses are present within the project vicinity but not currently present in the project area. Seagrasses are discussed in more detail in sections 2.4.1 and 2.4.3.1. No corals, coral reefs, or hardbottoms are currently present in the project area.

2.4.5 AIR QUALITY

There are two monitoring stations in Palm Beach County that detect air quality; Station L099-0008 at Belle Glade monitors particle pollution ($PM_{2.5}$), and Station L099-0021 at Lantana Preserve monitors particulate matter (PM_{10}), ozone (O_3), and Nitrogen Dioxide (NO_2). Analysis of the highest readings recorded throughout 2016 indicate $PM_{2.5}$, PM_{10} , O_3 , and NO_2 levels are compliant with the National Ambient Air Quality Standards set by the Environmental Protection Agency (EPA).



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FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

Figure 2- 4. Palm Beach County air monitoring locations. Altered from Florida Department of Environmental Protection (2016).

2.4.6 WATER QUALITY

SFWMD has several monitoring stations within Lake Worth Lagoon that measure salinity and pollutant levels. Water samples indicate elevated nutrient levels in C-51, C-16, and C-17 canals (Taylor Engineering, Inc., 2009), likely caused by agricultural and urban runoff entering the canals. A nine-year study concluded the central segment of the lagoon exhibited higher turbidity, total nitrogen (TN), and chlorophyll a (CHL) concentrations (Buzzelli et al., 2016).

2.4.6.1 SALINITY

The dominant influence on the salinity regime in Lake Worth Lagoon is from freshwater flows from the C-51, C-16, and C-17 canals. Other controlling factors on the salinity within the lagoon include salt intrusion from the Lake Worth tidal inlets, precipitation, and evaporation. Although tidal prism flushing does affect the salinity regime in areas close to the inlets, it does not significantly influence salinity in the central segment of Lake Worth Lagoon enough to balance the influence from freshwater flows during large discharge events.

Ongoing salinity monitoring at John’s Island beginning in April 2010 by Palm Beach County Environmental Resources Management indicates several trends in the data that clearly show the close relationship between discharge events at S-155 (the flood control spillway structure of C-51) and salinity levels in central Lake Worth Lagoon (Figure 2-5). As expected, the wet season typically brings increased rainfall totals and eventually leads to associated stormwater releases from S-155. A corresponding decrease in salinity has been observed immediately following each release and sustained until flow from S-155 slows or stops. Local rainfall without associated S-155 discharge events appears to have little significant impact on salinity levels. This is apparent as during the 2011 dry season there were multiple rainfall events that occurred without associated S-155 discharge, while salinity remained high during the same period.

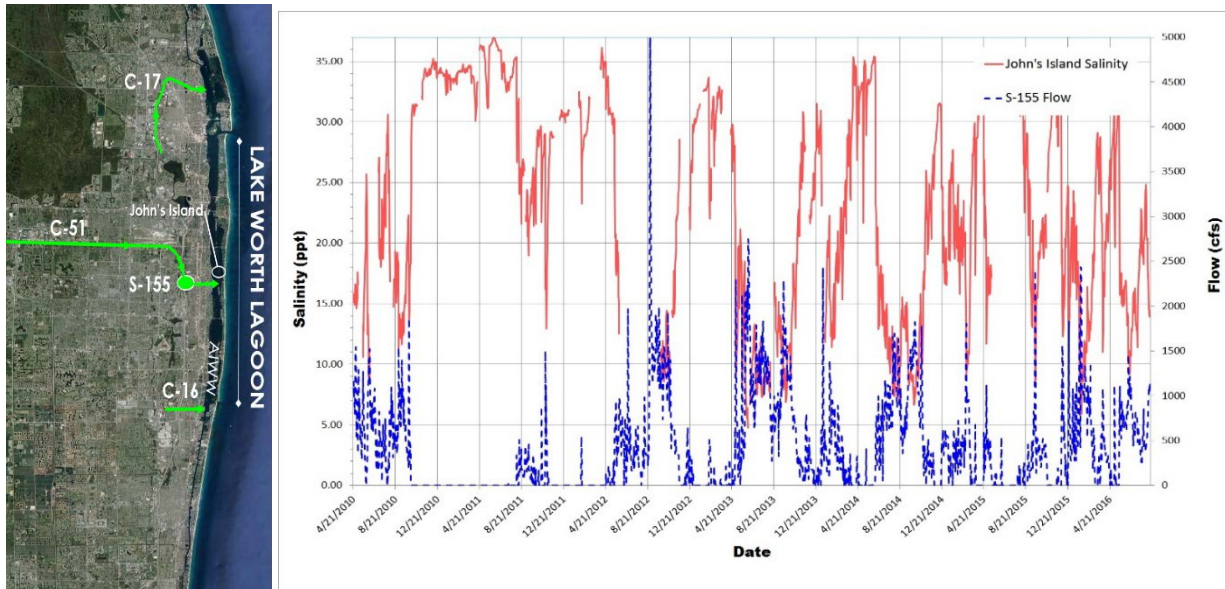


Figure 2- 5. John’s Island salinity and flow measurements.

2.4.7 NOISE

Noise in the Lake Worth Lagoon area is created by sources commonly found in natural and urban environments. Natural sources of ambient noise include weather (e.g. rain, thunder, etc.), waves and surf, and wildlife. Anthropogenic noise typically heard in heavily developed urbanized settings are intermixed with commercial and residential vehicles and vessels, emergency vehicles and systems, and retail facilities. The underwater acoustic environment in Lake Worth Lagoon is likely dominated by noise from vessels traversing the lagoon, however natural sources such as weather, water movement, and wildlife would also contribute to underwater ambient noise.

2.4.8 CULTURAL RESOURCES

Based on a literature assessment and search of the Florida Master Site File (FMSF), the six potential project areas (Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park, and Bonefish Cove (see Engineering Appendix, Figure 4-5) were reviewed by staff archaeologists of USACE, Jacksonville District. Prehistoric and historic archeological sites were found to be recorded within one mile of all the proposed potential project development locations. A submerged cultural resources survey conducted in 2000 by Mid-Atlantic Technology and Environmental Research, Inc. previously covered the Currie Park and El Cid potential project sites identifying nineteen potentially significant submerged targets along the IWW. None of the previously identified nineteen targets were determined to meet the eligibility criteria for inclusion in the National Register of Historic Places (DHR No. 2000-0019). The Corps initiated consultation with the Florida State Historic Preservation Office (SHPO) and appropriate federally recognized tribes through a letter dated August 30, 2016 requesting concurrence on the need for archaeological remote sensing survey of the Tarpon Flats, Snook East, Bryant Park South and Bonefish Cove potential project areas that have not been subject to previous submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the FMSF.

2.4.9 NATIVE AMERICANS

Numerous antiquities and cultural resources are recorded within the proposed project area. Amongst the previous recorded sites are resources that can be identified with Native American occupation. These resources include prehistoric campsites, shell middens, and burial mounds. No portion of this project affects Native American properties. Consultation with appropriate federally-recognized tribes is complete. USACE has discussed this project with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida in regard to its Section 106 responsibilities under the NHPA. The Corps initiated consultation with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians through a letter dated August 30, 2016 requesting concurrence on the need for archaeological remote sensing survey of the Tarpon Flats, Snook East, Bryant Park South and Bonefish Cove project areas that have not been subject to previous submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the FMSF. USACE received confirmation through the public comment process that the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida have no objections to the project at this time. (Exact comments received and Corps' responses can be reviewed in Appendix D-4 (Cultural Resources and Native Americans Resources Consultation) of this report.)

2.4.10 AESTHETIC AND RECREATION RESOURCES

There is a wide variety of recreational and aesthetic features in Lake Worth Lagoon. Public-use facilities, including those at John D. MacArthur Beach State Park, Phil Foster Park, South Cove Natural Area, and Snook Islands Natural Area offer visitors the opportunity to view diverse habitats present within the lagoon and view the results of several restoration efforts. Boats, kayaks, canoes, and water taxis frequent the lagoon's waters year-round. There are a total of six artificial reefs in Lake Worth Lagoon, which reduces the pressure on natural reef systems while still allowing snorkelers and SCUBA divers to see marine and estuarine organisms (Palm Beach County Department of Environmental Resources Management, 2009).

2.4.11 HAZARDOUS, TOXIC, AND RADIOACTIVE MATERIALS

Sediments within Peanut Island were dredged from Lake Worth Inlet and the IWW within Lake Worth Lagoon. Prior to recent construction activities involving ecorestoration of Peanut Island, or offloading material from the DMMA, a Phase 1 investigation was conducted by Palm Beach County in 1997. The conclusions of this investigation revealed no evidence of hazardous materials and did not recommend additional investigations for soil or groundwater contamination. More information on Hazardous, Toxic, and Radioactive Materials can be reviewed in the Engineering Appendix.

2.4.12 FUTURE WITHOUT PROJECT CONDITIONS (NO ACTION ALTERNATIVE) – NATURAL ENVIRONMENT

Conditions in the natural environment are expected to generally remain the same, though some habitat degradation will occur due to continued muck deposition. Water quality and recreational resources could vary in the future depending on human actions. Other projects (i.e. L-8 Reservoir, C-51 Phase I Reservoir, C-51 Phase II Reservoir) are expected to be completed within the project horizon that would limit flow through C-51. While these projects would lessen the amount of muck entering Lake Worth Lagoon, muck will continue to accumulate on existing muck-hole sites, which is not a suitable substrate for SAV and other lagoon species. With no action taken, the ongoing degradation of viable benthic habitat would continue to negatively impact EFH. Without the project, the potential for SAV and oyster growth would continue to diminish due to lack of suitable substrate. Less foraging opportunities could make the lagoon less enticing for listed species and other fish and wildlife.

2.5 SOCIO-ECONOMIC ENVIRONMENT

2.5.1 GENERAL

Palm Beach County, Florida has seen steady population growth from 2010 to 2014 averaging around 1.1% annual growth and gaining roughly 60,000 or roughly a 4.6% increase in population (Figure 2-6; Table 2-3). The 2016 estimate (Table 2-4) shows a 5.42% increase in population from the 2010 Census population. A nearly 30% increase in population is projected for 2045. However, the population growth rate will peak at nearly 7% around 2020 and continue to slow down reaching 2.93% in 2045 (Table 2-5).

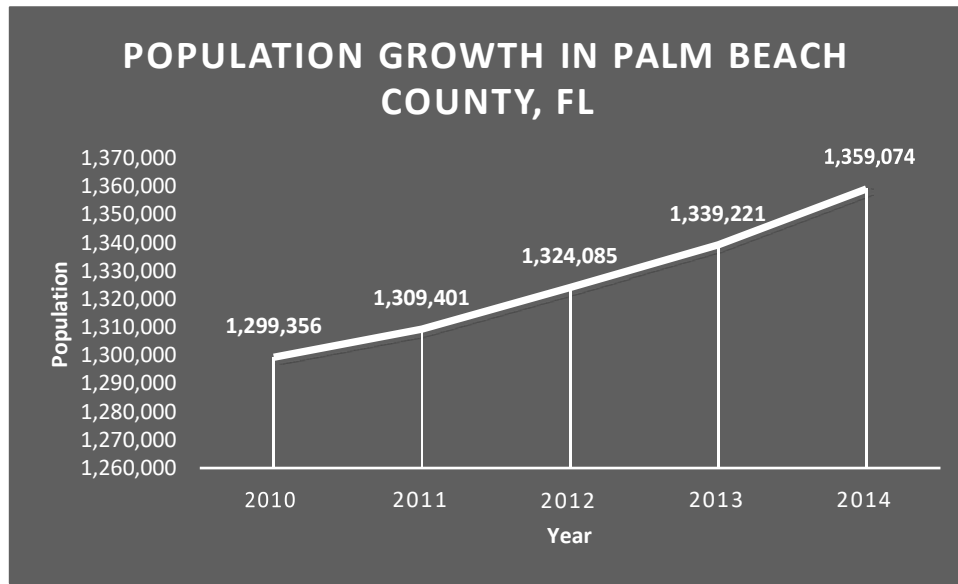


Figure 2- 6. Palm Beach County population growth from 2010-2014.

Table 2- 3. 2010-2014 population growth for Palm Beach County.

	Total population	Percent Growth
2010	1,299,356	
2011	1,309,401	0.767%
2012	1,324,085	1.109%
2013	1,339,221	1.130%
2014	1,359,074	1.461%

Table 2- 4. 2016 population estimate.

	2010 Census	2016 Estimate	Total Change	Percent Change
Palm Beach County	1,320,134	1,391,741	71,607	5.42%
Florida	18,801,332	20,148,654	1,347,322	7.17%

Table 2- 5. Palm Beach County projected population percent growth.

	2015	2020	2025	2030	2035	2040	2045
Total Population	1,378,417	1,472,586	1,554,902	1,623,972	1,684,415	1,738,116	1,789,034
Percent Change		6.83%	5.59%	4.44%	3.72%	3.19%	2.93%

2.5.2 LOCAL ECONOMY AND DEMOGRAPHICS

Sex & Age

The female population is larger than the male by several percentage points. This trend has stayed relatively stable over the five year period. Nearly 40% of the population falls between the ages of 25 and

54. Roughly 25% of the population is below the age of 25 and around 20% is above the age of 64. For the most part, these patterns have remained stable over the five year period. The greatest change is a roughly 1% increase in 65-74 year olds as a share of the population. In general the elderly population is growing while the younger population is shrinking (Table 2-6).

Table 2- 6. Population age breakdown for Palm Beach County.

	2010	2011	2012	2013	2014	
Under 5 years	5.45%	5.40%	5.33%	5.27%	5.21%	
5 to 9 years	5.72%	5.62%	5.54%	5.55%	5.50%	
10 to 14 years	5.69%	5.73%	5.75%	5.69%	5.65%	
15 to 19 years	6.12%	6.08%	6.08%	6.01%	5.90%	
20 to 24 years	5.48%	5.55%	5.66%	5.72%	5.77%	
25 to 34 years	10.97%	11.02%	11.10%	11.20%	11.36%	
35 to 44 years	13.26%	12.90%	12.56%	12.26%	12.04%	
45 to 54 years	14.06%	14.13%	14.13%	14.10%	14.00%	
55 to 59 years	6.18%	6.31%	6.28%	6.50%	6.56%	
60 to 64 years	5.63%	5.70%	5.87%	5.79%	5.87%	
65 to 74 years	9.57%	9.73%	9.94%	10.16%	10.40%	
75 to 84 years	8.32%	8.18%	7.93%	7.78%	7.74%	
85 years and over	3.55%	3.66%	3.84%	3.97%	3.99%	

Race

Palm Beach County remains majority white. However minority populations have seen growth over the five year period. There has however been a nearly a 2% increase of the Hispanic portion of the population and a nearly 1% increase in the black population (Table 2-7).

Table 2- 7. Racial breakdown for Palm Beach County.

	2010	2011	2012	2013	2014	
White	74.74%	75.51%	76.23%	75.83%	75.46%	
Black	16.83%	17.03%	17.32%	17.53%	17.74%	
American Indian	0.21%	0.21%	0.18%	0.18%	0.18%	
Asian	2.27%	2.33%	2.38%	2.36%	2.48%	
Pacific Islander	0.05%	0.05%	0.05%	0.05%	0.05%	
Other	4.44%	3.33%	2.12%	2.06%	2.07%	
Two or More Races	1.45%	1.54%	1.71%	1.99%	2.01%	
Hispanic	17.97%	18.54%	19.07%	19.51%	19.98%	

Economy

The vast majority of the labor force is employed in service sector jobs, with production and construction like sectors employing less than 20% of the labor force. The natural resources, construction and maintenance sector has declined more than a percentage point. However, sales and office occupations

have also declined by around a percentage point. Service occupations have increased by roughly two percentage points (Table 2-8).

Table 2- 8. Occupation sectors of Palm Beach County.

	2010	2011	2012	2013	2014	
Management, business, science, and arts occupations	34.32%	34.68%	35.28%	35.37%	35.39%	
Service occupations	20.43%	21.17%	21.51%	21.84%	22.05%	
Sales and office occupations	27.87%	27.43%	26.76%	26.58%	26.44%	
Natural resources, construction, and maintenance occupations	10.28%	9.52%	9.20%	9.05%	8.97%	
Production, transportation, and material moving occupations	7.10%	7.20%	7.25%	7.17%	7.15%	

Unemployment

The labor force has declined slightly while unemployment has increased nearly two percentage points (Table 2-9).

Table 2- 9. Labor force and unemployment for Palm Beach County.

	2010	2011	2012	2013	2014	
In labor force	60.48%	60.32%	60.28%	60.37%	60.23%	
Unemployed	9.00%	10.49%	11.22%	11.81%	10.79%	

Income and Assistance

More than 30% of households make between \$35,000 and \$74,999. More than 35% of households make below the \$35,000 threshold. There have been no dramatic changes in household incomes. The percentage of households that receives Food Stamps/SNAP benefits has increased remarkably by around four percentage points. The portion of households receiving supplementary security income has also increased roughly a percentage point (Table 2-10).

Table 2- 10. Household income breakdown of Palm Beach County.

	2010	2011	2012	2013	2014	
Less than \$10,000	6.26%	6.41%	6.44%	6.43%	6.42%	
\$10,000 to \$14,999	5.00%	5.20%	5.15%	5.27%	5.19%	
\$15,000 to \$24,999	10.69%	10.73%	10.94%	11.13%	11.03%	
\$25,000 to \$34,999	10.65%	10.41%	10.69%	10.61%	10.71%	
\$35,000 to \$49,999	14.44%	14.44%	14.32%	14.41%	14.14%	
\$50,000 to \$74,999	18.02%	17.87%	17.81%	17.71%	17.27%	
\$75,000 to \$99,999	11.78%	11.42%	11.19%	11.22%	11.42%	
\$100,000 to \$149,999	12.55%	12.53%	12.55%	12.30%	12.50%	
\$150,000 to \$199,999	4.44%	4.71%	4.72%	4.73%	4.94%	
\$200,000 or more	6.17%	6.26%	6.19%	6.20%	6.37%	

2.5.3 LAND USE

Land use within Lake Worth Lagoon is primarily characterized as developed urban and residential areas (National Land Cover Database (NLCD), 2011). Although there are undeveloped and agricultural areas within the watershed, the majority of land directly surrounding the project area is classified as developed.

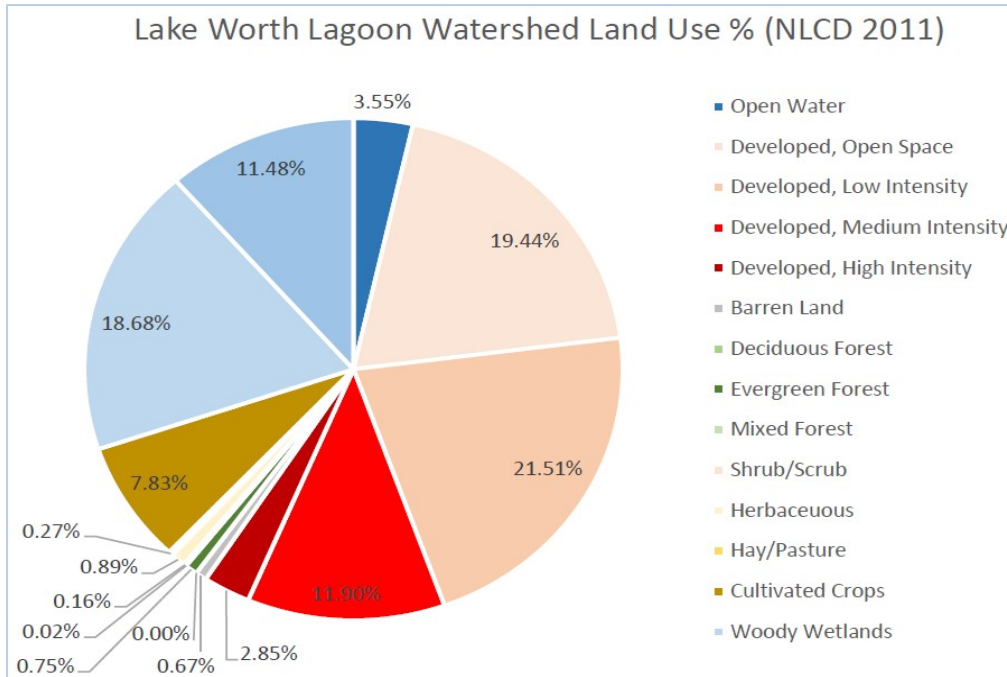


Figure 2- 7. Lake Worth Lagoon watershed land use allocation. From NLCD (2011).

Table 2- 11. Comparison of undeveloped and developed land use within the Lake Worth Lagoon watershed. From NLCD (2011).

Category	Land Cover Class	Percentage	Total
Water	Open Water	3.55%	3.55%
Developed	Developed, Open Space	19.44%	55.70%
	Developed, Low Intensity	21.51%	
	Developed, Medium Intensity	11.90%	
	Developed, High Intensity	2.85%	
Undeveloped	Barren Land	0.67%	40.75%
	Deciduous Forest	0.00%	
	Evergreen Forest	0.75%	
	Mixed Forest	0.02%	
	Shrub/Scrub	0.16%	
	Herbaceous	0.89%	
	Hay/Pasture	0.27%	
	Cultivated Crops	7.83%	
	Woody Wetlands	18.68%	
	Emergent Herbaceous Wetlands	11.48%	

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3 PLAN FORMULATION

The CAP guiding principle is to deliver quality projects to the customer in minimum time and cost, and is consistent with current federal laws and policies. CAP projects are of a limited scope and complexity; therefore, larger or more complex or costlier projects should be addressed under specifically authorized programs and not under the CAP authority. Under the USACE's current CAP authority, the Federal project cost limit share for a CAP Section 1135 project is \$10 million dollars.

3.1 PROBLEMS AND OPPORTUNITIES

The purpose of this feasibility study is to develop an implementable and acceptable plan to change the future condition and address specific problems and opportunities in the study area under CAP. Problems and opportunities have been identified by the Project Delivery Team (PDT) in several ways, including previous USACE studies, reports completed by private contractors for Palm Beach County, Florida, as well as a scoping letter inviting comments from all Federal and state agencies, appropriate federally recognized tribes, and interested parties and individuals on the proposed project.

3.1.1 PROBLEMS

Existing problems within the study area include:

- Freshwater discharges from the C&SF project via canals C-16, C-17, and C-51 induce sudden changes from brackish to low salinity conditions within the lagoon, which can last hours or days. Although these canal discharges to the lagoon provide flood damage reduction benefits for upland urban and agricultural areas within the drainage area, floodwater discharges, particularly from C-51, have the ability to temporarily reduce salinity within the lagoon enough to result in negative impacts on the marine ecosystem.
- Delivery of fine-grained sediments and muck with discharges via canals C-16, C-17, and C-51 gradually cover the natural sands and hard bottom on the lagoon floor, and negatively impact or totally cover oyster beds and other benthic features. These canal discharges transport fine-grained sediments (muck) and attached nutrients (i.e. phosphorous, nitrogen) to the lagoon where they may contribute to water clarity, sedimentation, and algae bloom problems in the lagoon.

3.1.2 OPPORTUNITIES

Opportunities are positive conditions in the study area that may result from implementation of a Federal project such as:

- To provide ecosystem restoration solutions that create sustainable habitat for marine ecosystem flora and fauna within Lake Worth Lagoon by developing potential ecological solutions that can withstand the impacts of the C&SF project freshwater deliveries and fine-grained muck sedimentation via canals C-16, C-17, and C-51.

3.2 CONSTRAINTS

3.2.1 PLANNING CONSTRAINTS

Constraints are designed to avoid undesirable changes between the without and with-project future conditions that would affect the achievement of ecosystem benefits. The planning constraints relative to this study are:

1. The project solutions must not encroach within 100 ft of the IWW right-of-way, both during construction and throughout the duration of the project life.
2. Structural integrity of the dikes on Peanut Island must be maintained when offloading placement material from the DMMA so that they may be used for future storage of dredge material from inland navigation sites
3. The project must not alter, redirect, or limit freshwater inflows from any C&SF canal.
4. The project solutions must maintain right-of-way for IWW and Palm Beach Federal Channel by limiting any construction, including rock placement, within 100 feet.
5. Recognize that C&SF flood control features will continue to feed freshwater into the lagoon.

3.2.2 LOCAL CONSTRAINTS

Local and state laws, such as Florida State statutes, do not impose constraints on the National Economic Development (NED) benefits – of which NER formulation is a subset. However, consideration is given to local and state laws when selecting a plan or when considering a Locally Preferred Plan (LPP). At this time, there is no LPP. The sponsor is in full support of the Recommended Plan.

3.3 OBJECTIVES

While the Section 1135 LWL CAP project cannot prevent future activities that may continue to cause impacts similar to those observed and discussed in the problems identified above, the Section 1135 LWL CAP project can create a project that is more resilient to the conditions and still has an environmental restoration benefit that is viable and sustainable.

3.3.1 PLANNING OBJECTIVES

The following study objectives were developed based on Lake Worth Lagoon 1135 CAP project problems, opportunities, goals, federal objectives, and state objectives and regulations.

- Maximize sustainable seagrass habitat in project area within 5 years
- Maximize nursery habitat for invertebrates/juvenile fishes in project area within 5 years
- Maximize fish habitat near project area within 5 years
- Maximize recruitment of epifauna/infauna benthic organisms in project area within 5 years
- Maximize bird habitat, including habitat for migratory bird and other wildlife in project area within 5 years

3.3.2 FEDERAL ENVIRONMENTAL OBJECTIVES

This report is an integrated feasibility study and environmental document. This document describes the environmental effects of the Recommended Plan and summarizes compliance with federal statutes and regulations in a manner consistent with USACE Environmental Operating Principles (EOPs). These principles are consistent with NEPA, the Army's Environmental Strategy with its four pillars (prevention, compliance, restoration, and conservation), and other environmental statutes that govern USACE

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activities. Public participation is encouraged early in the planning process to help define problems and environmental concerns relative to the study. Therefore, it is very important early on in the planning process to identify any alternatives under consideration that are likely to affect (both favorably as well as adversely) significant environmental resources and values. All formulated plans strive to avoid any adverse impacts on significant resources to the extent fully practicable. If significant adverse impacts are unavoidable, then Section 906(d) of WRDA 1986 requires mitigation of these impacts. Finally, the implementation framework proposed as part of this study seeks to work collaboratively by fully engaging individuals, agencies, and local groups in identifying, planning, and implementing solutions that maximize sustainable habitat within Lake Worth Lagoon.

3.4 SUMMARY OF MANAGEMENT MEASURES

The main goal of this project is to provide an ecosystem solution that creates a sustainable marine ecosystem habitat for flora and fauna within Lake Worth Lagoon. In order to meet the project objectives, both structural and non-structural management measures looked at ways of satisfying one or multiple project objectives. The following is a list of the structural and non-structural management measures given consideration for meeting this goal:

Non-Structural

- NS-1: adjust/change water control schedule to reduce flows being discharged through the S-155 structure into LWL
- NS-2: divert freshwater flows into a reservoir to reduce accumulation of muck and minimize negative salinity impacts from freshwater pulses

Structural

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2: placement of sandy dredge material over muck sediments in dredge hole to create seagrass habitat
- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a 1:8 side slope with armoring at toe
- S-3: removal of muck and placement of sandy dredge material over muck sediments in dredge hole to creation of infauna habitat
- S-4: planting mangroves to create mangrove habitat

SCREENING OF MANAGEMENT MEASURES

Screening is the ongoing process of eliminating measures from further consideration based on planning criteria. Reduction of freshwater flows from S-155 (NS-1) was removed by the PDT during preliminary screening because it did not meet the constraints of USACE's flood control mission. Additionally, diverting freshwater flows into a reservoir (NS-2) was also removed by the PDT because it would have been too cost prohibitive to build a reservoir that would positively affect salinity and sediment accumulation in Lake Worth Lagoon under a limited CAP budget. Finally, removal of existing muck and placement of sandy dredge material (S-3) was not carried forward because muck removal from the lagoon proved to be cost prohibitive and no suitable sites for material relocation were found.

3.5 ALTERNATIVE DEVELOPMENT

Using the management measures described above, the PDT initially considered an array of eight alternatives (including the No Action Alternative) based on existing dredge-hole sites around Lake Worth

Lagoon. The initial array of alternatives were evaluated against site location acceptability, ability of the project to be sustainable over the project life, cost-effectiveness, and technical feasibility. A description of the final array of alternatives, along with initial alternatives that did not meet the screening criteria are discussed in this section.

3.5.1 NO ACTION

The No Action Alternative will not implement any management measures or construct any type of project features to improve the marine ecosystem of LWL.

3.5.2 ALTERNATIVE 1A: ISLAND CREATION AT EL CID

The intent of this alternative is to create an island chain at El Cid that will promote mangrove growth while helping to establish and sustain oyster reef development around the islands (Figure 3-1). Island construction will use borrow material from the Peanut Island Dredge Material Management Area (DMMA), located 6.0 miles northeast of the project site. In addition to planting mangrove seedlings and placing artificial reef modules (2' x 3'), construction efforts will require the installation of rip rap around the islands to protect them from erosive forces due to wave actions occurring within the lagoon. Placement of borrow material from the DMMA will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds around the islands. This alternative will create ~26 acres of suitable habitat for listed species, fish, birds, seagrasses, and other benthic organisms.

The management measures implemented are:

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a 1:8 side slope with armoring at toe
- S-4: planting mangroves to create mangrove habitat

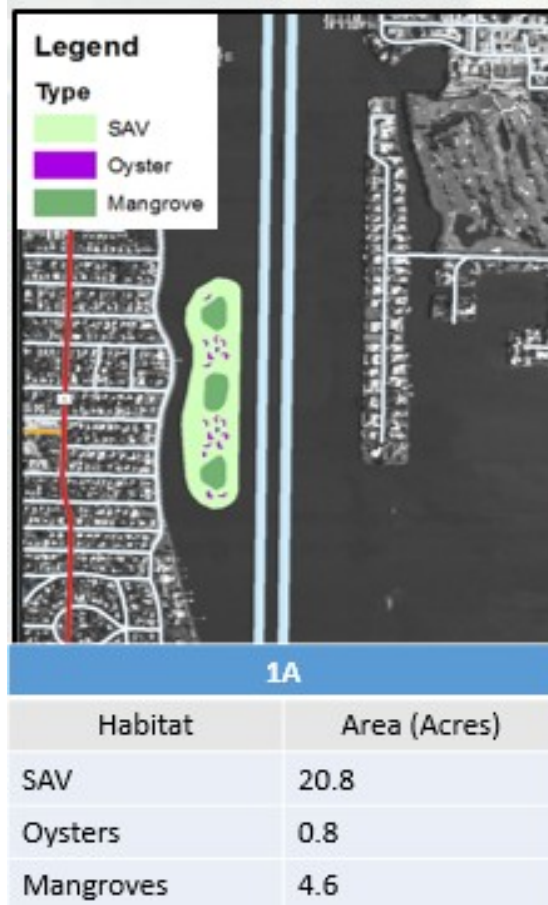


Figure 3- 1. Location of Alternative 1A (~26 acres of potential habitat).

3.5.3 ALTERNATIVE 1B: ISLAND CREATION AT BONEFISH COVE

The intent of this alternative is to create an island chain at Bonefish Cove that will promote mangrove growth while helping to establish and sustain oyster reef development around the islands. Island construction will use borrow material from the Peanut Island Dredge Material Management Area (DMMA), located approximately 11.8 miles northeast of the project site. In addition to planting mangrove seedlings and placing artificial reef modules (2' x 3'), construction efforts will require the installation of rip rap around the islands to protect them from erosive forces due to wave actions occurring within the lagoon. Placement of borrow material from the DMMA will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds around the islands. This alternative will create ~50.0 acres of suitable habitat for listed species, fish, birds, seagrasses, and other benthic organisms.

The management measures implemented are:

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2: placement of sandy dredge material over muck sediments in dredge hole to create seagrass habitat

- S-4: planting mangroves to create mangrove habitat



Figure 3- 2. Alternative 1B (~50 acres of potential habitat).

3.5.4 ALTERNATIVE 2A: SAND CAPPING AT EL CID

The intent of this alternative is to cap existing muck sediments to create suitable oyster reef habitat at El Cid (Figure 3-3). Muck sediments will be capped using borrow material from the Peanut Island DMMA to form a flat slope over the project site. Placement of artificial reef modules (4' 10" x 6') on top of the borrow material will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds at the project site. This alternative will create ~25 acres of suitable habitat for listed species, fish, seagrasses, and other benthic organisms.

The management measures implemented are:

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a 1:8 side slope with armoring at toe



Figure 3- 3. Alternative 2A (~25 acres of potential habitat).

3.5.5 ALTERNATIVE 2B: SAND CAPPING AT BONEFISH COVE

The intent of this alternative is to cap existing muck sediments to create suitable oyster reef habitat at Bonefish Cove (Figure 3-4). Muck sediments will be capped using borrow material from the Peanut Island DMMA to form a flat slope over the project site. Placement of artificial reef modules (4' 10" x 6') on top of the borrow material will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds at the project site. This alternative will create ~48 acres of suitable habitat for listed species, fish, seagrasses, and other benthic organisms.

The management measures implemented are:

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2: placement of sandy dredge material over muck sediments in dredge hole to create seagrass habitat



Figure 3- 4. Alternative 2B (~48 acres of potential habitat).

3.5.6 OTHER ALTERNATIVES CONSIDERED BUT SCREENED OUT: 3A, 3B, 3C, 3D

In addition to the alternatives listed above, the PDT initially considered four other alternatives (3A (Currie Park); 3B (Tarpon Flats); 3C (Bryant Park South); 3D (Snook East)) for this project (Figure 3-5). These alternatives would have consisted of hydraulically dredging muck using a hydraulic cutterhead or auger dredge and replacing the hole with fill material from the Peanut Island DMMA and artificial reef modules at different locations in Lake Worth Lagoon. These alternatives would have created infauna and oyster habitat, but were screened out for several reasons (see below). See Engineering Appendix, Section 4.3.7 for a full analysis of potential project sites.

- Site location concerns: Although Currie Park (Alternative 3A) is the second largest dredge hole in LWL, the most recent seismic survey conducted within the lagoon did not extend to this project site, and thus overall sediment characterization is not available. Currie Park is also approximately six miles north of C-51, and was determined to not be a viable project site for restoration because it is too far north of where most of the freshwater flow exists. Alternative 3B (Tarpon Flats) is located at the mouth of S-155 and would likely experience frequent salinity fluctuations and a faster rate of sedimentation when compared to sites located further away. Site 3B was also screened out because it is in a narrow area of the lagoon due to John’s Island to the north and Ibis

Island to the east. Putting another feature in this area would likely exacerbate tidal and wind-driven currents.

- Cost-effectiveness and technical feasibility: Hydraulically dredging muck would require turbidity measures, along with a suitable location to dewater and dispose the displaced muck. This would likely be too expensive under the CAP Authority and would not provide significant lifts in habitat benefits.

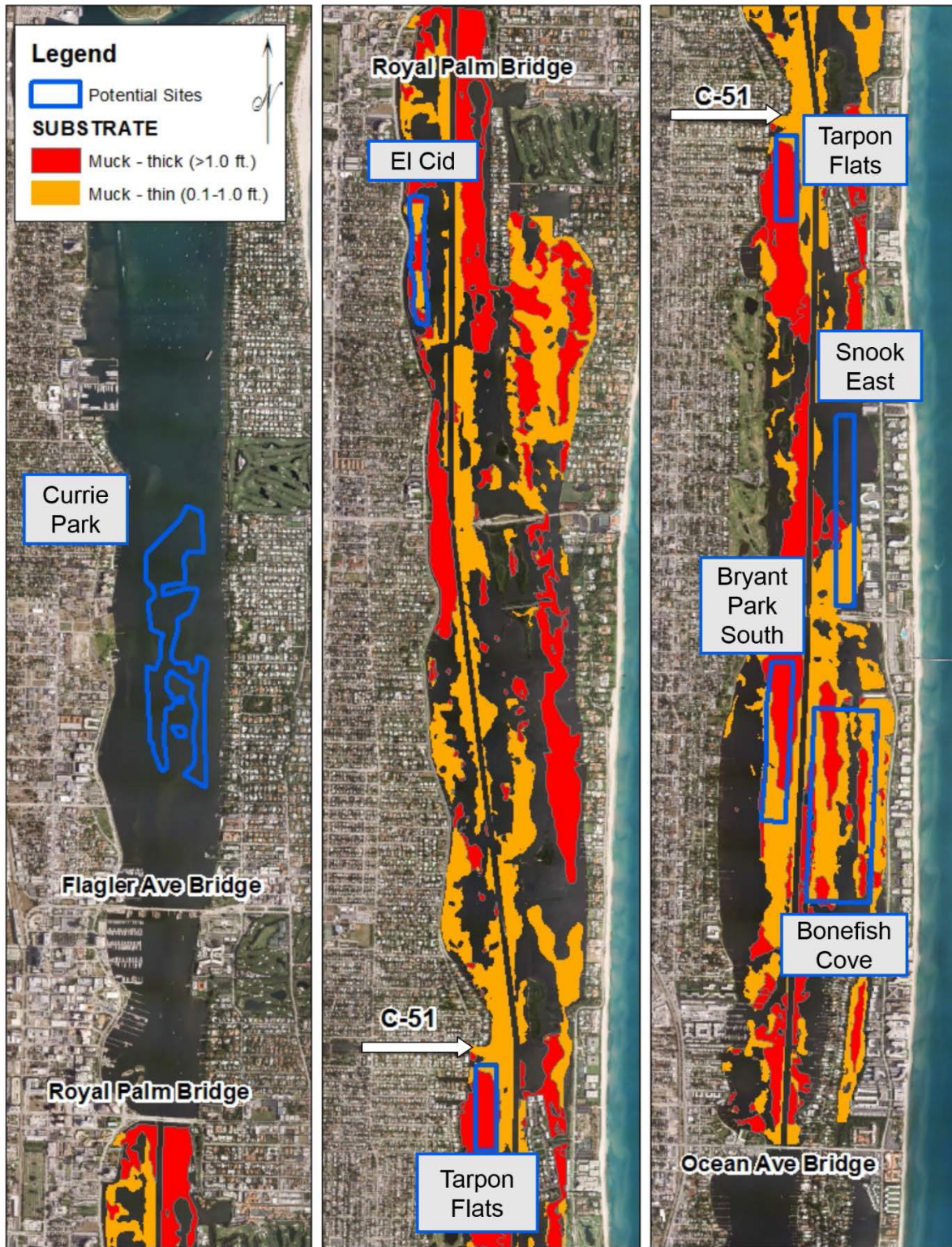


Figure 3- 5. Location of all alternative sites initially considered by the PDT and corresponding muck thicknesses. El Cid = 1A/2A; Bonefish = 1B/2B.

3.5.7 SCREENING OF FINAL ALTERNATIVES

The final array of alternatives considered for implementation (No Action, 1A, 2A, 1B, 2B) were evaluated for their success in meeting the Planning Objective, including Purpose and Need; and the Planning Constraints, including technical feasibility, environmental acceptability, habitat analysis, and economic feasibility. The evaluation criteria considered the alternatives according to their overall acceptability. As stipulated under the CAP 1135 Authority, Cost Effectiveness/Incremental Cost Analysis (CE/ICA) should focus alternative solution. A discussion of the evaluations follows, with a summary of findings and screening results shown in Table 3-3.

3.5.8 ENVIRONMENTAL EFFECTS OF ALTERNATIVES

This section is the scientific and analytic basis for the comparisons of the alternatives: 1A, 2A, 1B, and 2B. The No Action alternative is described in detail in Sections 2.2.5, 2.3.3, 2.4.9, 2.5.4, and is thus not included in this section. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effects.

3.5.8.1 GENERAL ENVIRONMENTAL EFFECTS

Construction activities within Lake Worth Lagoon would temporarily impact the aesthetics due to the presence of construction equipment within the project area. Heavy construction equipment (i.e. barge, excavator, heavy earth moving equipment) would be visible to the public. Overall, effects from construction activities are expected to be temporary and this project will have a positive effect on the environment within Lake Worth Lagoon.

3.5.8.2 VEGETATION

3.5.8.2.1 ALTERNATIVE 1A

Alternative 1A is expected to have an overall positive effect on vegetation. There are no known existing SAV species located at this site as of 2013 (Palm Beach County Department of Environmental Resources Management, 2013), but results from other restoration projects within Lake Worth Lagoon indicate high potential for SAV species to self-recruit once a suitable substrate is in place. Preliminary designs conclude that the creation of ~20.8 acres of SAV habitat is possible with this alternative, which would provide habitat for a number of marine species. This alternative also includes planting ~4.6 acres of mangroves, which would also provide habitat for Lagoon species and would help protect the substrate from erosion and muck deposition.

3.5.8.2.2 ALTERNATIVE 2A

Alternative 2A is expected to have similar beneficial effects as Alternative 1A. Preliminary designs conclude that the creation of ~19.8 acres of SAV habitat is possible with this alternative. However, this alternative does not include planting mangroves and thus this alternative is not expected to have as positive of an impact on vegetation because there will be no mangroves to help protect SAV from erosion and muck deposition. The flat-slope design of Alternative 2A does not provide protection from erosion and muck deposition, and is therefore inherently more sensitive sea level rise. It is likely that sand capping will not provide as great of benefits to SAV as island creation over the duration of the project life.

3.5.8.2.3 ALTERNATIVE 1B

Alternative 1B is expected to have similar beneficial effects as Alternative 1A. Preliminary designs indicate ~37.6 acres of SAV habitat will be created and ~11.1 acres of mangroves will be planted, which is approximately 23.3 acres more habitat than would be created in Alternative 1A. Although no existing SAV species are present within the project area, a small portion of the project area contains a potential area of unvegetated seagrass habitat (Palm Beach County Department of Environmental Resources Management, 2013; Figure 3-6). The zone of potential seagrass habitat is also present directly east of the project site. This project would likely increase the area for potential seagrass habitat.

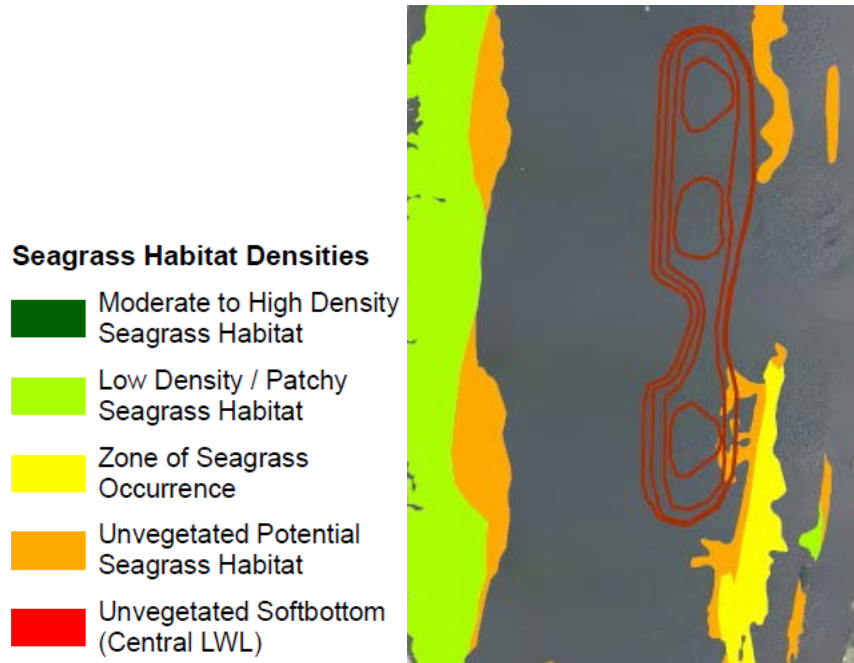


Figure 3- 6. Lake Worth Lagoon seagrass habitat map at Bonfish. From Palm Beach County Department of Environmental Resources Management (2013).

3.5.8.2.4 ALTERNATIVE 2B

Alternative 2B is expected to have similar beneficial effects as Alternative 1A. Preliminary designs conclude ~39.3 acres of SAV habitat would be created with this alternative. However, this alternative does not include planting mangroves and thus this alternative is not expected to have as positive of an impact on vegetation because there will be no mangroves to help protect SAV from erosion and muck deposition.

3.5.8.3 FISH AND WILDLIFE RESOURCES (OTHER THAN THREATENED AND ENDANGERED SPECIES)

3.5.8.3.1 ALTERNATIVE 1A

Alternative 1A will provide an overall benefit to fish and wildlife species. The project will create early life stage habitats for fish and provide protection for fish and benthic organisms. Placement of suitable substrate and limestone rock will create habitat for algal and macroinvertebrate species, increasing the biodiversity and community productivity within the Lagoon. Mangroves will provide nesting grounds for migratory birds and will stabilize the substrate that fish utilize to forage and rest. There may be temporary effects to fish and wildlife species during construction, but these impacts are expected to be minor.

3.5.8.3.2 ALTERNATIVE 2A

Alternative 2A will provide an overall benefit to fish and wildlife species. The project will create early life stage habitats for fish and provide protection for fish and benthic organisms. Placement of suitable substrate and limestone rock will create habitat for algal and macroinvertebrate species, increasing the biodiversity and community productivity within the Lagoon. There may be temporary effects to fish and wildlife species during construction, but these impacts are expected to be minor.

3.5.8.3.3 ALTERNATIVE 1B

Alternative 1B will provide similar benefits to fish and wildlife species as described in Alternative 1A.

3.5.8.3.4 ALTERNATIVE 2B

Alternative 2B will provide similar benefits to fish and wildlife species as described in Alternative 2A.

3.5.8.4 THREATENED AND ENDANGERED SPECIES

USACE has reviewed the biological, status, threats, and distribution information presented in this assessment. Based on preliminary consultation, USACE believes that the following species have the potential to be in or near the project area and thus must be considered as part of the design and construction:

- Smalltooth Sawfish (*Pristis pectinata*)
- Johnson's Seagrass (*Halophila johnsonii*)
- West Indian (Florida) Manatee (*Trichechus manatus latirostris*)
- Loggerhead Sea Turtle (*Caretta caretta*)
- Green Sea Turtle (*Chelonia mydas*)
- Hawksbill Sea Turtle (*Eretmochelys imbricata*)
- Leatherback Sea Turtle (*Dermochelys coriacea*)
- Migratory Birds

USACE has concluded the project may affect, but is not likely to adversely affect (MANLAA) the species listed above and will not affect any designated critical habitat (DCH). Coordination under Section 7 of the ESA with the USFWS and the NMFS was initiated on January 20, 2017. A copy of the USFWS Section 7 ESA concurrence letter was received on March 15, 2017. A copy of the NMFS Section 7 ESA concurrence letter was received August 18, 2017. ESA coordination correspondence is included in Appendix D (Environmental).

3.5.8.4.1 ALTERNATIVE 1A

Alternative 1A is expected to have overall positive impacts on listed species that utilize Lake Worth Lagoon because it will create approximately 26.2 acres of beneficial habitat for several listed species. First, Johnson's seagrass is expected to be positively affected because this alternative would create suitable substrate that would encourage natural recruitment. Second, the Florida manatee and sea turtles would also be positively affected because this alternative will create more foraging area for these species to utilize. Conversion of the subtidal footprint to mangrove islands, sea grass and oyster reef habitat will create potential resting, foraging, and nesting habitat for migratory species passing through the area.

3.5.8.4.2 ALTERNATIVE 2A

Alternative 2A is expected to create approximately 25.2 acres of habitat for listed species and have similar beneficial effects as described in Alternative 1A. SAV and oyster colonies will provide habitat for listed species, though the created habitat will not provide protection from erosion and muck deposition and is therefore not expected to provide as high quality of habitat for listed species as the island creation alternatives over the life of the project.

3.5.8.4.3 ALTERNATIVE 1B

Alternative 1B is expected to have similar beneficial effects to listed species as described in Alternative 1A. However, alternative 1B would create approximately 49.9 acres of beneficial habitat for listed species, which is 23.7 acres more than the acreage of alternative 1A.

3.5.8.4.4 ALTERNATIVE 2B

Alternative 2B is expected to create approximately 47.5 acres of habitat and have similar beneficial effects to listed species as described in Alternative 2A.

3.5.8.5 ESSENTIAL FISH HABITAT

Each alternative will provide an overall benefit to fish habitat and seagrasses. While the placement of dredged material to create islands will impact the non-motile benthic community, these impacts would cease with the completion of construction. Benthic repopulation within the impacted areas should occur with organisms migrating from similar adjacent habitat. Any impacts to mobile marine organisms, such as fish, are expected to be insignificant and temporary as these organisms are able to relocate and avoid direct physical effects. Placement of suitable substrate and limestone rock will create habitat for algal and macroinvertebrate species, increasing the biodiversity and community productivity within the lagoon. The overall benefits of the project will create viable habitat for seagrasses and fish as well as provide protection for fish and benthic organisms as the islands and associated features establish.

3.5.8.6 CULTURAL RESOURCES AND HISTORIC PROPERTIES

On 22 and 23 September, 2016 Tidewater Atlantic Research, Inc. (TAR) conducted a remote sensing survey of the Bonefish Cove project area to locate and identify any magnetic anomalies and/or acoustic targets that could be associated with historic vessel remains or other potentially significant submerged cultural resources. Data was collected along 17 survey transects spaced at 30-meter intervals utilizing a cesium vapor magnetometer, dual-frequency digital sidescan sonar, and chirp sub-bottom profiler. TAR's survey resulted in the identification of 96 anomalies. Six of these anomalies identified in three clusters were assessed by TAR to have signature characteristics that were strongly suggestive of historic vessel remains. Based on analysis of the data, TAR recommended project activities be designed to avoid three site buffers that are projected 200 ft from the targets. None of the remaining magnetic anomalies were assessed to have association with potentially significant submerged cultural resources. Consultation with SHPO and the appropriate federally recognized tribes regarding the project is complete. In the event of unexpected finds, the following procedures will be followed: If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or

written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.

Consultation in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulation in 36 CFR Part 800: Protection of Historic Properties was continued through letter mailed on May 3, 2017 to the SHPO requesting their comment on the determination of no effect for project activities within the surveyed area and on the draft report entitled: Phase 1 Submerged Cultural Resource Remote Sensing Survey of A Proposed Restoration Site at Bonefish Cove inn Lake Worth Lagoon, Palm Beach County, Florida. In a letter (DHR No. 2016-3626-B) dated June 2, 2017, USACE received concurrence from SHPO that the project will have no effect on historic properties eligible for inclusion in the NRHP. (Coordination documents are included in Appendix D-4 (Cultural Resources and Native Americans Resources Consultation)).

3.5.8.6.1 ALTERNATIVES 1A and 2A

On August 30, 2016, USACE consulted with the SHPO regarding the initial development of the project. The SHPO concurred with the USACE's recommendation that submerged remote sensing cultural resources assessment surveys have been previously conducted for the El Cid project area (Alternatives 1A and 2A), and that proposed activities in this study area would have no effect on historic properties (DHR Project File No. 2016-3626).

3.5.8.6.2 ALTERNATIVES 1B and 2B

On August 30, 2016, USACE consulted with the SHPO regarding the initial development of the project. SHPO concurred with USACE's recommendation that submerged remote sensing cultural resources assessment surveys should be conducted for the Bonefish Cove project area (Alternatives 1B and 2B) by letter correspondence dated September 6, 2016 (DHR Project File No. 2016-3626). Based on Tidewater Atlantic Research, Inc.'s preliminary target assessment in a letter dated 29 September 2016, the remote sensing cultural resources survey of the Bonefish Cove study area (Alternatives 1B and 2B) resulted the identification of four targets identified in two clusters that were assessed to have signature characteristics that were strongly suggestive of historic vessel remains. The identified resources will be properly buffered from each target to ensure required protection of the resource. It is anticipated that no historic properties would be affected by selection of these project alternatives. Consultation with SHPO and appropriate federally recognized tribes is complete.

3.5.8.7 RECREATION

All action alternatives are not expected to affect recreation within Lake Worth Lagoon. The IWW will remain open for boating and other recreational activities. Though the alternatives do not provide any recreational elements, there is a potential for passive recreation (e.g. bird watching, fishing) at the alternative sites.

It is not intended, nor expected, that this project would affect the physical attributes, economic benefits, recreational enjoyment by the community, and/or wildlife habitat associated with Peanut Island while collecting material for placement at any of the alternative sites. It is the intention of USACE to maintain a safe environment for recreation throughout Lake Worth Lagoon.

3.5.8.8 WATER QUALITY

There could be temporary impacts to water quality, mainly turbidity during construction at each project site. Construction equipment may release small amounts of pollutants into the water, including oils and grease. Best management practices will be used to limit the possibility of negatively affecting water quality. Detailed pollution control plans will be developed during the design phase.

3.5.8.8.1 ALTERNATIVE 1A

Alternative 1A is expected to have minimal effect on the overall water quality within Lake Worth Lagoon, but improvements to water clarity are expected at the project site due to the islands' sloped design and the filtering capabilities of oysters and mangroves.

3.5.8.8.2 ALTERNATIVE 2A

Alternative 2A is expected to have minimal effect on the overall water quality within Lake Worth Lagoon, but improvements to water clarity are expected at the project site due to the filtering capabilities of oysters.

3.5.8.8.3 ALTERNATIVE 1B

Alternative 1B is expected to have minimal effect on the overall water quality within Lake Worth Lagoon, but improvements to water clarity are expected at the project site due to the islands' sloped design and the filtering capabilities of oysters and mangroves.

3.5.8.8.4 ALTERNATIVE 2B

Alternative 2B is expected to have minimal effect on the overall water quality within Lake Worth Lagoon, but improvements to water clarity are expected at the project site due to the filtering capabilities of oysters.

3.5.8.9 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

All of the alternatives would use fill material from the Peanut Island DMMA. A Phase I investigation conducted on Peanut Island by Palm Beach County in 1997 concluded there was no evidence of hazardous materials based on the American Society of Testing and Materials (ASTM) Standard 1527-94. There have been no significant changes to Peanut Island since this time and material from the DMMA has been used to construct subsequent projects (i.e. Snook Island, Grassy Flats). Sediment is regulated under the Clean Water Act (CWA). HTRW is not a concern due to the fact that the fill material is borrow from the Peanut Island DMMA, and is high quality sand from nearby dredging activities within the region. During the dredging process, most the fines are washed out leaving the coarse silica particles (quartz sand (SP)) in the DMMA. Currently the sand from the DMMA is being used to restore low laying areas and other minor permitted restoration projects. None of the alternatives are expected to be adversely impacted by HTRW. There are no known sources or producers of hazardous or toxic materials within the project area.

3.5.8.10 AIR QUALITY

There would be no long-term effects on air quality for all of the alternatives. The project will not construct any new sources of air pollution. Construction vehicles may temporarily increase air emissions in the immediate project vicinity through the release of carbon monoxide and other pollutants from fuel combustion.

Further, the contractor shall be required to comply with applicable air pollution standards of the State of Florida (Florida Statute, Chapter 403 and others and Chapters 200 series of the FAC) Commonwealth Territorial and all Federal emission and performance laws and standards, including the U.S. Environmental Protection Agency's Ambient Air Quality Standards.

3.5.8.11 CLIMATE

The project will not change the project area's climate. Minimal amounts of greenhouse gases would be created during construction of the proposed project; however, the release of Green House Gas (GHG) emissions will cease with completion of construction. The creation of mangrove islands and oyster and sea grass habitat may aid in the natural carbon capture and/or carbon sequestration processes.

3.5.8.12 NOISE

There would be no long-term changes to noise levels for all of the alternatives. However, construction vehicles and equipment may temporarily increase noise in the immediate project vicinity. Preliminary project designs call for the use of heavy construction equipment, but elevated noise levels are expected to be temporary within the study area.

3.5.8.13 PUBLIC SAFETY

This project would not have any impact on the safety of the public.

3.5.8.14 ENERGY REQUIREMENTS AND CONSERVATION

The energy requirements for project activities would be confined to fuel for construction equipment, labor, transportation, and other construction equipment.

3.5.8.15 NATURAL OR DEPLETABLE RESOURCES

No depletable resources would be used other than the fossil fuels used to power equipment.

3.5.8.16 REUSE AND CONSERVATION POTENTIAL

This project would not directly present any reuse or conservation potential.

3.5.8.17 SCIENTIFIC RESOURCES

This project would not have any impact on scientific resources.

3.5.8.18 NATIVE AMERICANS

No portion of this project affects Native American properties. Consultation with appropriate federally-recognized tribes is complete. USACE has discussed this project with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida in regard to its Section 106 responsibilities under the NHPA. The Corps initiated consultation with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians through a letter dated August 30, 2016 requesting concurrence on the need for archaeological remote sensing survey of the Tarpon Flats, Snook East, Brayan Park South and Bonefish Cove project areas that have not been subject to previous submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the Florida Master Site File. USACE received confirmation through the public comment process that the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida have no objections to the project at this time. (Exact comments received and Corps' responses, can be reviewed in Appendix D-4 (Cultural Resources and Native Americans Resources Consultation) of this report.)

Pursuant to Section 106 of the NHPA (16 USC 470) obligations regarding USACE Trust Responsibilities to federally-recognized Native American Tribes, and in consideration of Burial Resources Agreement between USACE and the Seminole Tribe of Florida, consultation was continued through letter mailed on May 3, 2017 to the federally-recognized Seminole Tribe of Florida and Miccosukee Tribe of Indians of

Florida requesting their comment on the determination of no effect for project activities within the surveyed area and on the draft report entitled: Phase 1 Submerged Cultural Resource Remote Sensing Survey of A Proposed Restoration Site at Bonefish Cove inn Lake Worth Lagoon, Palm Beach County, Florida. (Coordination documents are included in Appendix D-4 (Cultural Resources and Native Americans Resources

LAKE WORTH LAGOON 1135 CAP PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

Consultation)).

3.5.8.19 DRINKING WATER

None of the alternatives will impact drinking water.

3.5.8.20 INVASIVE SPECIES

None of the alternatives would introduce or impact invasive species already present within Lake Worth Lagoon.

3.5.8.21 CUMULATIVE IMPACTS

A cumulative impact is an "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 C.F.R. 1508.7).

An inherent part of the cumulative effects analysis is the uncertainty surrounding actions that have not yet been fully developed. The CEQ (1997) regulations provide for the inclusion of uncertainties in the EA analysis, and state that when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking" (40 C.F.R. Section 1502.22). The CEQ regulations do not say that the analysis cannot be performed if the information is lacking. Consequently, the analysis contained in this section includes what could be reasonably anticipated to occur given the uncertainty created by the lack of detailed investigations to support all cause and effect linkages that may be associated with the Recommended Plan.

The geographic areas used for the scope of this analysis vary for each affected resource. For example, air quality is generally evaluated on a county by county basis by USEPA, so the cumulative effects for air quality would be evaluated by this bounding area. Marine resources, however, are affected only within the waters of Lake Worth Lagoon. Relevant past, current, and future projects have been included in the cumulative impact analysis. However, the uncertainty of future trends and the inability to foresee how planned elements of the C&SF project will subsequently affect the Lagoon once constructed allows for only a general evaluation of future trends.

The project is within the vicinity of the IWW, which is permitted for O&M activities. In addition to the projects and prior studies discussed in section 1.5, the general public as well as the state and local governments could have permitted activities in or around the project area. Federal activities have been evaluated under NEPA directly for each project. Other projects that take place in-water or would impact wetlands would be evaluated under a permit issued by USACE Regulatory Division. These activities are not expected to have significant effects on the environment individually or cumulatively. The proposed action would result in long-term benefits, which should outweigh any environmental effects associated with construction of the project (i.e. turbidity associated with sand placement). As this project will create suitable habitat, cumulative impacts to EFH and ESA listed species are expected to be positive.

It is reasonably foreseeable that the Town of Palm Beach may place 57,000 cubic yards of maintenance dredged material into the proposed Bonefish Cove placement site. The proposed placement of maintenance dredged material is a separate and distinct action; therefore, the town's project must be constructed with independent utility. The Lake Worth Lagoon 1135 CAP project's existing conditions were evaluated on the known environment and features currently present in the project area and vicinity at the time the report

was written. A pre-construction survey to confirm bathymetry and volume calculations will be performed during the project's Design and Implementation phase. If the town of Palm Beach's project is permitted and constructed prior to the CAP project's construction, changes in the existing conditions would be identified and adjustments to the CAP project's design would be incorporated. The Corps will revisit analysis and determine whether additional coordination may be needed at that time.

3.5.9 HABITAT BENEFIT ANALYSIS OF THE FINAL ALTERNATIVES

To facilitate the selection of a preferred alternative and to ensure that the federal government is investing funds in the most cost-effective plans, USACE requires that the benefits be quantified so that relative levels of habitat benefit (output) can be compared to the costs. Each habitat restoration measure will be analyzed using the following Habitat Suitability Indices (HSI) model that was developed following the HEP (Habitat Evaluation Procedures) methodology.

HEP was developed by USFWS (1980) to facilitate the identification of impacts from various federal actions on fish and wildlife habitat. HEP can provide numeric scores for existing conditions at a project site, potential future without-project conditions, and various action alternatives for a species or assemblage of species in a particular geographic area. HEP is implemented by the use of one or more HSIs, which are mathematical relationships designed to represent the habitat suitability of an area for a single species or assemblage of species as well as different life stages of a species or assemblage of species. A set of variables that represent the habitat requirements for the species (e.g. salinity, water depth, substrate) is combined into a mathematical model. The variables are then measured and their corresponding index values are inserted into the model to produce a score that describes existing habitat suitability. The value is an index score between 0 and 1, though a perfect score of 1.0 was not found to exist within the project area and is considered unlikely to be found within an urban setting.

Although approval of planning models under EC 1105-2-412 is not required for CAP projects (Civil Works Policy Memorandum #1 [January 19, 2011]), the principles to ensure quality continue to be necessary. Models and analysis must be compliant with USACE policy, theoretically sound, computationally accurate, and transparent. The variables developed for this HSI are based upon data in the literature of species habitat requirements and preferences and are inherently based on best professional judgment. The basis for the HSI and its application was reviewed by USACE discipline specialists, federal and state agency representative technical experts, and non-federal sponsor technical experts familiar with habitat evaluation procedures.

Suitable HSI models must include habitat variables for which data collection is possible or data are already available. Variables must also show a change in score between the existing and proposed condition. If the project does not affect the suitability index score for a species, it will not be possible to quantify an effect. The suitability indices (SIs) for various habitat parameters for the species are combined arithmetically or geometrically to yield an overall index score for the species.

The purpose of this project is to identify and implement self-sustaining ecosystem-based habitat improvement actions that would provide the attributes necessary to support flora and fauna species within Lake Worth Lagoon. Therefore, HSI have been developed to evaluate ecosystem benefits that SAV, oyster, and mangrove provide to the Lagoon (Table 3-2).

3.5.9.1.1 Habitat Suitability Indices

The following parameters were used to develop HSI:

Existing Benthic Environment

The presence of either SAV or oysters in the vicinity of alternative sites was considered when assigning HSI. Both El Cid and Bonefish are located near productive oyster and SAV colonies, but the small segment of unvegetated potential seagrass habitat at Bonefish (Figure 3-6) was considered a strong indicator that Bonefish would be successful at creating healthy habitats for Lagoon species.

Existing Substrate

Fine-grained sediments (muck) entering the Lake Worth Lagoon from S-155 contain high levels of nutrients and dissolved organic matter. Muck sediments easily re-suspend and prevent light penetration through the water column, which severely inhibits the ability of oyster and SAV colonies to thrive. Analysis of existing data from Dial Cordy (2011) indicates ~47% of El Cid is covered by sand sediments, while only ~5% of Bonefish is covered by sand. A higher ratio of sand to muck is assumed to be an indicator of a site’s future protection from muck re-deposition. Additional sediment probes collected at El Cid by USACE in 2014 indicate muck (silt) thickness varies from 0 to 3.8 ft, averaging 0.8 ft with a median of 0.5 ft (Engineering Appendix, Figure 4-7). Recently collected muck probes by Palm Beach County indicate that there is 0 to 4 feet of muck present at Bonefish Cove (Engineering Appendix, Figure 4-10).

Table 3- 1. Existing sediment coverage at the alternative sites.

Existing Site Parameters		
Sediment Type	Coverage Area (Acres)	
	El Cid (1A/2A)	Bonefish (1B/2B)
Sand	12.02	2.28
Muck (< 1 ft thick)	6.37	30.30
Muck (> 1 ft thick)	7.17	14.97

Proximity to S-155

Discharges from S-155 are responsible for the majority of damaging runoff into Lake Worth Lagoon. Freshwater flows drastically reduce salinity levels which lower productivity and can even cause death to sensitive species. Bonefish is located ~3.0 miles from S-155, while El Cid is ~3.3 miles from S-155. However, Snook Islands (a previously completed restoration project located closer to S-155 than Bonefish and El Cid) has demonstrated success at creating suitable habitat for Lagoon species and thus indicates that the influence of S-155 on the final array of alternative sites is minimal.

Proximity to IWW

Research indicates a negative relationship between recreational boating and the health of SAV and oyster species (Wall et al., 2005; National Park Service; Klein, R., 2007). Boat wakes have been attributed to widespread dead margins in oyster reefs and cause erosion of oyster beds. SAV are particularly vulnerable to boating activity and are easily damaged by propellers and dredging activities. Of the two proposed alternative sites, El Cid (Alt 1A/2A) provides the best protection because it is located further from the IWW.

Wind and Wave Conditions

The majority of Lake Worth Lagoon is exposed to wind-generated waves and boat wakes. Fetch lengths, wave heights, and peak wave periods analyzed at the alternative sites indicate that El Cid is far more susceptible to wind and wave energy than Bonefish (Table 4-4, Engineering Appendix). Although island creation at El Cid would help protect the armored shore to the west, swell and storm waves generated

along the eastern side of El Cid would exacerbate erosion and negatively impact the ability of the site to maintain suitable habitat throughout the project life. While Bonefish would be subject to similar boat wakes and storm waves, it would not experience the level of fetch issues as El Cid because the westward exposure has much less likely wind and wave occurrences. Additionally, several high-rise condominiums are located directly east of Bonefish Cove and will provide protection against winds.

Table 3- 2. Habitat Suitability Indices for each alternative.

Performance Criteria	Habitat Suitability Indices											
	1A			2A			1B			2B		
	EX	FWO	FWP	EX	FWO	FWP	EX	FWO	FWP	EX	FWO	FWP
SAV	0.20	0.15	0.65	0.20	0.15	0.30	0.30	0.25	0.75	0.30	0.25	0.40
Oyster	0.10	0.05	0.50	0.10	0.05	0.25	0.10	0.05	0.60	0.10	0.05	0.30
Mangrove	0	0	0.77	0	0	0	0	0	0.87	0	0	0

Summary of Habitat Suitability

All alternatives were assigned HSI scores for existing (EX), future without project (FWO), and future with project (FWP) conditions. It was assumed that the habitable environment in the FWO condition would degrade linearly for each project site based continued muck accumulation. That assumption was also used when assigning FWP scores for Alternatives 2A and 2B because the flat-sloped design would not help prevent continued muck accumulation, unlike Alternatives 1A and 1B which would limit sedimentation and create habitat more capable to adapt to sea level rise.

Alternatives that include island creation (1A and 1B) received much higher HSI scores than the sand capping alternatives (2A and 2B) for several reasons. First, studies indicate fine sediments are not as likely to accumulate in intertidal areas, which would only be achieved in alternatives 1A and 1B. Second, mangroves will stabilize the substrate and help prevent erosion and sediment re-suspension. Finally, mangrove islands will provide shoreline protection from wind and wave energy, a project objective that sandcapping would not accomplish. Table 3-3 provides a summary of the acceptability of the final array of alternatives.

Table 3- 3. Screening of Alternatives (N = no; Y = yes; N/A = not applicable).

Possible Alternatives	Planning Objectives		Planning Constraints			Screening Result
	Meets Purpose and Need	Sustainable	Technically Feasible	Environmentally Acceptable	Economically Feasible	
No Action	N	N/A	Y	N	Y	Not Acceptable
1A/1B	Y	Y	Y	Y	Y	Acceptable
2A/2B	Y	N	Y	Y	Y	Not Acceptable
3A/3B/3C	N	N	N	N	N	Not Acceptable

3.5.9.1.2 Habitat Units

Habitat Units (HUs) were calculated by multiplying the HSI scores for the top two alternatives (1A and 1B) by the total acreage of suitable habitat created. Total HUs are calculated using the following equation:

Equation 3-1. Habitat Unit Calculation.

$$HUs = HSI \text{ Score} \times \text{Habitat Area (in Acres)}$$

Table 3- 4. Total number of Habitat Units created for the top two alternatives.

Performance Criteria	Habitat Units					
	Alternative 1A			Alternative 1B		
	FWP	Area (Acres)	Habitat Units	FWP	Area (Acres)	Habitat Units
SAV	0.65	19.8	12.9	0.75	37.6	28.2
Oyster	0.50	0.8	0.4	0.60	1.2	0.7
Mangrove	0.77	4.6	3.5	0.87	11.1	9.7
Total Habitat Units			17			39

The HU values are used in the CE/ICA for cost analysis, which can be found in the following section.

3.5.9.1.3 Cost Effectiveness and Incremental Cost Analysis

The final evaluation of measures and alternative plans includes a Cost Effectiveness (CE) / Incremental Cost Analysis (ICA) consistent with USACE guidance. The CE/ICA is an evaluation tool which considers and identifies the relationship between changes in cost and changes in quantified, but not monetized, habitat benefits. The evaluation is used to identify the most cost-effective alternative plans to reach various levels of restoration output and to provide information on whether different (increasing) levels of restoration are worth the added cost. The CE/ICA is a planning tool to help identify cost-effective plans which provide a certain level habitat output at the least cost. The results provide an array of alternatives which undergo a tradeoff analysis and can be screened out based on a plan’s acceptability, completeness, effectiveness, and efficiency.

For this study, the IWR-Planning Suite software was used to conduct the CE/ICA. The CE/ICA uses costs developed the rough order of magnitude (ROM) costs at the October 2016 (FY17) price level. Each alternative was compared to a No Action alternative to determine benefits based on habitat quality ratings and costs to create a final array. Table 3-5 displays the ROM cost for each alternative (for construction costs only), the average annual cost (at the FY17 discount rate of 2.875% for a fifty year period of analysis), estimated construction duration, and the habitat units plan output for each alternative. The plans are displayed in order of increasing costs. The shaded plans were screened out since they produce lesser habitat unit output at a greater cost than the previous non-shaded plan. Alternative 1A and 1B were carried into the final array of alternatives as cost effective plans.

Table 3- 5. Cost effective analysis for the initial array of alternatives (construction cost only).

Alternative Restoration Plan ID	Plan Cost (ROM)	Average Annual Cost CRF (i=2.875%, n=50)	Construction Duration	Plan Outputs (Habitat Units)	Cost per Unit Output	Cost Effective (Yes/No)
No Action Plan	0		N/A	0	0	N/A
Alternative 1A	\$5,900,000	\$223,894	5 months	13.8	\$16,234	Yes
Alternative 2A	\$6,200,000	\$235,278	5.5 months	4.0	\$58,136	No
Alternative 1B	\$10,500,000	\$398,455	9 months	29.2	\$13,644	Yes
Alternative 2B	\$11,200,000	\$425,019	7 months	8.5	\$49,867	No

Note: Sorted from lowest to highest cost

Table 3-6 displays the final array of alternatives, the subset of cost effective plans that are the best financial investments, called “Best Buy” plans. Best Buy plans are incrementally cost effective plan that results in the “least average annual cost per unit output,” as was compared in the initial array of

alternatives. The plan costs used for the ICA are MCACES-level for construction and non-construction costs (Table 3-6). Alternative 1B is the NER plan and the Recommended Plan as it provides additional habitat output at a lower incremental cost per unit and has a total project cost within the CAP authority limit for Section 1135 projects. It is noted that once identified as the Recommended Plan, Alternative 1B costs were further refined for reduction for volume of material for mangrove and seagrass. Table 3-6 reflects the updated incremental cost analysis for the cost per plan, which maintains Alternative 1B as the “Best Buy” and NER plan.

It is noted that once identified as the Recommended Plan, Alternative 1B costs were further refined based on reduction of material due to mangrove and seagrass after Agency Technical Review. As certified costs of the Recommended Plan were refined through District Quality Control and South Atlantic Division Review, a sensitivity analysis was performed to verify that the costs didn't increase enough to warrant reformulation of the CE/ICA in the report. Costs increased 2%, which maintains Alternative 1B as the “Best Buy” and NER plan. The certified costs of the Recommended Plan is approximately \$11,973,000 (Table 4-2).

Table 3- 6. Incremental cost analysis of the final array of alternatives.

Alternative	Plan Cost (MCACES) Construction and Non-Construction Cost	Average Annual Plan Cost (MCACES Level)	Plan Outputs (Habitat Units)	Incremental Habitat Unit	Incremental cost Per Plan	Incremental Cost per Habitat Unit
No Action Alternative	---	0	0	0	0	0
Alternative 1A	\$9,100,000	\$345,328	13.8	13.8	\$345,328	\$25,039
Alternative 1B	\$13,500,000	\$512,299	29.2	15.4	\$166,972	\$10,834

Recommended Plan Benefits

Alternative 1B (creation of eco-island at Bonefish Cove) – was selected as the Recommended Plan because it produces the greatest amount of habitat units at the lowest cost per habitat unit. The Recommended Plan will create an approximately 50 acre eco-island chain at the Bonefish Cove dredge site in LWL (Figure 3-6, Table 3-6). The eco-islands will consist of approximately 345,000 yards of borrow material taken from the Peanut Island DMMA allowing the creation of 11 acres of planted mangrove seedlings and 1 acre of oyster habitat as part of the eco-island chain. The building of the islands on a low slope will provide approximately 38 acres of SAV habitat that is sustainable in the current and future Lake Worth environment of changing salinities and muck accumulation. These actions will create a complex ecosystem that provides suitable habitat to invertebrates/juvenile fishes, infauna/benthic organisms and migratory birds.

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4 RECOMMENDED PLAN

The goal of the Recommended Plan (Alternative 1B) is to raise the existing bathymetry to the intertidal range and cover the existing muck material with clean sand. Fill material to be used for the project will be excavated and transported from Peanut Island – the same sediment source used for creating the Snook Islands and Grassy Flats. Peanut Island is 6.0 miles and 11.8 miles away, respectively, from the El Cid and Bonefish Cove sites. The goal of this alternative is to create three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of 2' x 3' artificial reef modules scattered around the islands (Figure 4-1).

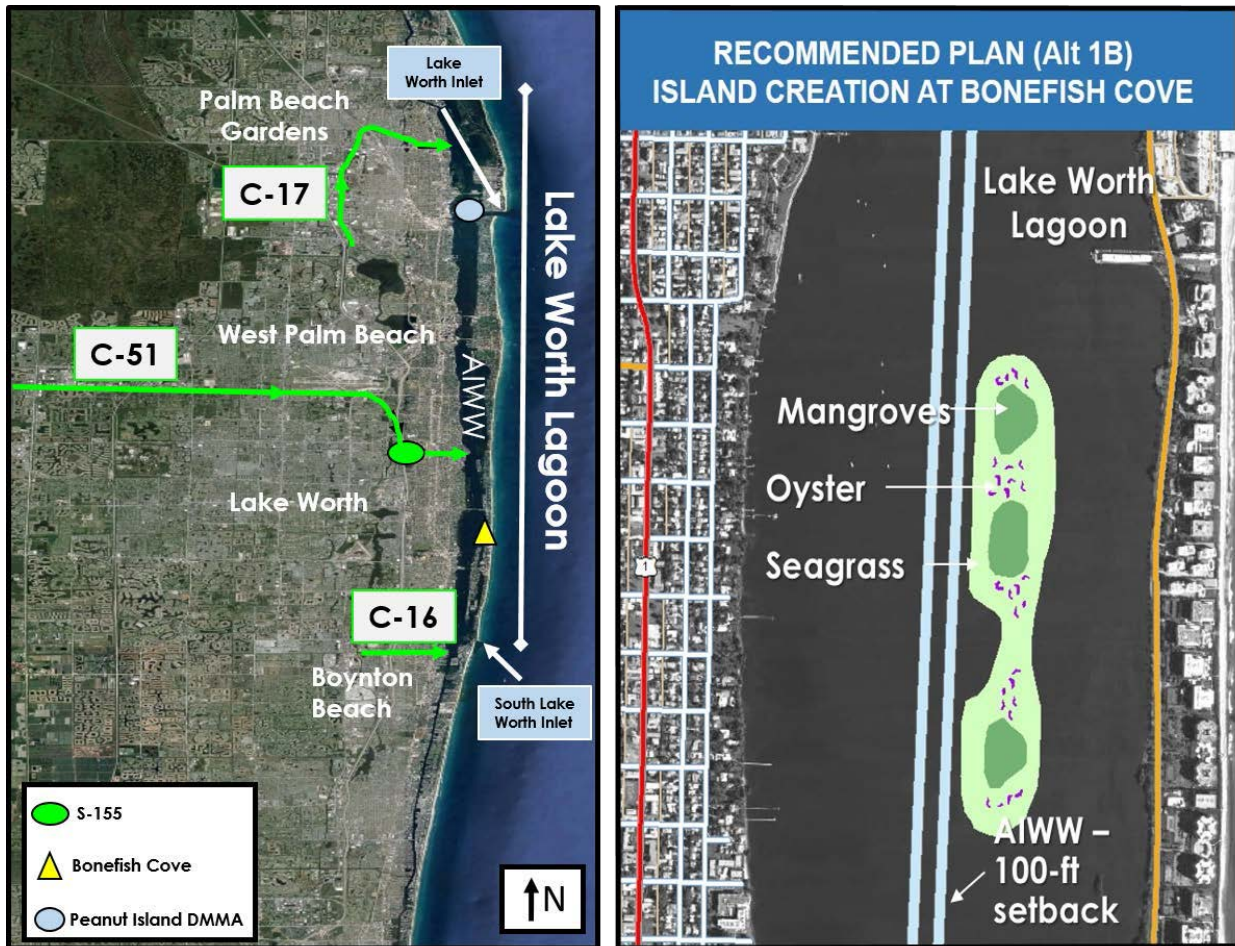


Figure 4- 1. Location and features of the Recommended Plan.

4.1 RECOMMENDED PLAN BENEFITS

Alternative 1B (creation of eco-island at Bonefish Cove) – was selected as the Recommended Plan because it produces the greatest amount of habitat units at the lowest cost per habitat unit. The Recommended Plan will create an approximately 50 acre eco-island chain at the Bonefish Cove dredge site in LWL (Table 4-1). The eco-islands will consist of approximately 345,000 yards of borrow material taken from the Peanut Island DMMA allowing the creation of 11 acres of planted mangrove seedlings and 1 acre of oyster habitat as part of the eco-island chain. The building of the islands on a low slope will provide

approximately 38 acres of SAV habitat that is sustainable in the current and future Lake Worth environment of changing salinities and muck accumulation. These actions will create a complex ecosystem that provides suitable habitat to invertebrates/juvenile fishes, infauna/benthic organisms and migratory birds.

Table 4-1 displays the final array of alternatives, the subset of cost effective plans that are the best financial investments, called “Best Buy” plans. Best Buy plans are incrementally cost effective plan that results in the “least average annual cost per unit output,” as was compared in the initial array of alternatives. The plan costs used for the incremental cost analysis (ICA) are MCACES-level for construction and non-construction costs (Table 4-1). Alternative 1B is the NER plan and the Recommended Plan as it provides additional habitat output at a lower incremental cost per unit and has a total project cost within the CAP authority limit for Section 1135 projects. It is noted that once identified as the Recommended Plan, Alternative 1B costs were further refined for reduction for volume of material for mangrove and seagrass. Table 4-1 reflects the updated incremental cost analysis for the cost per plan, which maintains Alternative 1B as the “Best Buy” and NER plan.

It is noted that once identified as the Recommended Plan, Alternative 1B costs were further refined based on reduction of material due to mangrove and seagrass after Agency Technical Review. As certified costs of the Recommended Plan were refined through District Quality Control and South Atlantic Division Review, a sensitivity analysis was performed to verify that the costs didn't increase enough to warrant reformulation of the CE/ICA in the report. Costs increased 2%, which maintains Alternative 1B as the “Best Buy” and NER plan. The certified costs of the Recommended Plan is approximately \$11,973,000 (Table 4-2).

Table 4- 1. Incremental cost analysis of the final array of alternatives.

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Alternative 1A	\$9,100,000	\$345,328	13.8	13.8	\$345,328	\$25,039
Alternative 1B	\$13,500,000	\$512,299	29.2	15.4	\$166,972	\$10,834

4.2 DESIGN AND CONSTRUCTION CONSIDERATIONS

The construction effort will consist transporting the fill material from Peanut Island to the selected project site to create three different substrate levels. The base or bed of the island will be raised to - 5.5 feet NAVD88, which will be achieved on a 12.5 % slope (1 foot vertical to 8 feet horizontal) from existing bathymetry and offset from the IWW right-of-way. The interior base of the island which is where the 2’ x 3’ artificial reef modules will be placed will be elevated to - 3.5 feet NAVD88 on a 4% slope (1 foot vertical to 25 feet horizontal), approximately one foot below mean low water (MLW), or - 2.5 feet

NAVD88. To complete the island creation project, three mangrove islands will be established to -0.5 feet NAVD88 on a 17% slope (1 foot vertical to 6 feet horizontal) (Figure 4-2). In addition, the project would include the installation of riprap for shoreline protection and island stabilization. Riprap sizing is assumed to be similar to the type constructed at the Snook Islands and Grassy Flats projects (2'- 3' limestone boulders). The post-construction features will include the creation of red mangrove habitat and installation of artificial reef modules for oyster reefs. Seagrass will not be planted because it is anticipated the elevated substrates would provide enough benefit for natural seagrass recruitment. Figure 4-3 illustrates the plan layout for Alternative 1B for both locations, and Figure 4-4 is typical cross-section for the Recommended Plan. For more design considerations and engineering analysis, see Engineering Appendix.

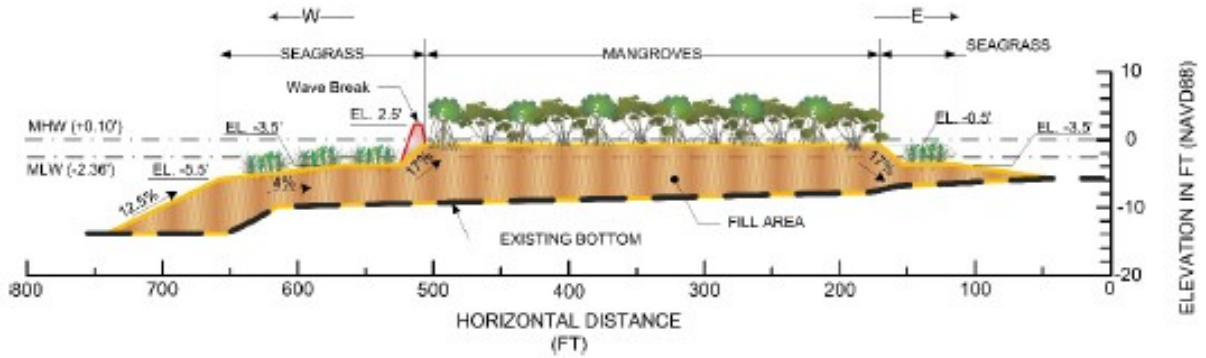


Figure 4- 2. Elevation profile of the Recommended Plan.

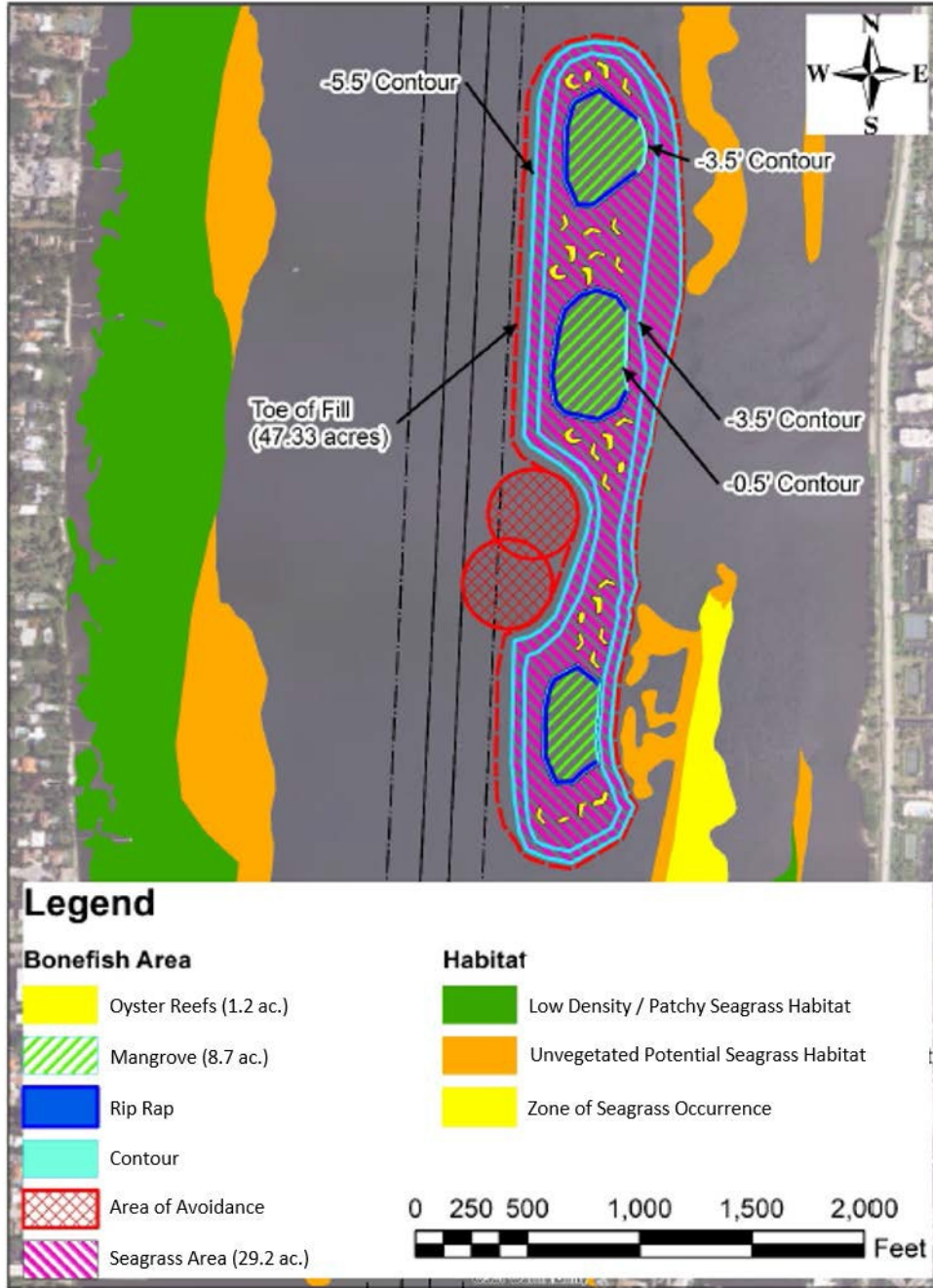


Figure 4- 3. Recommended Plan layout.

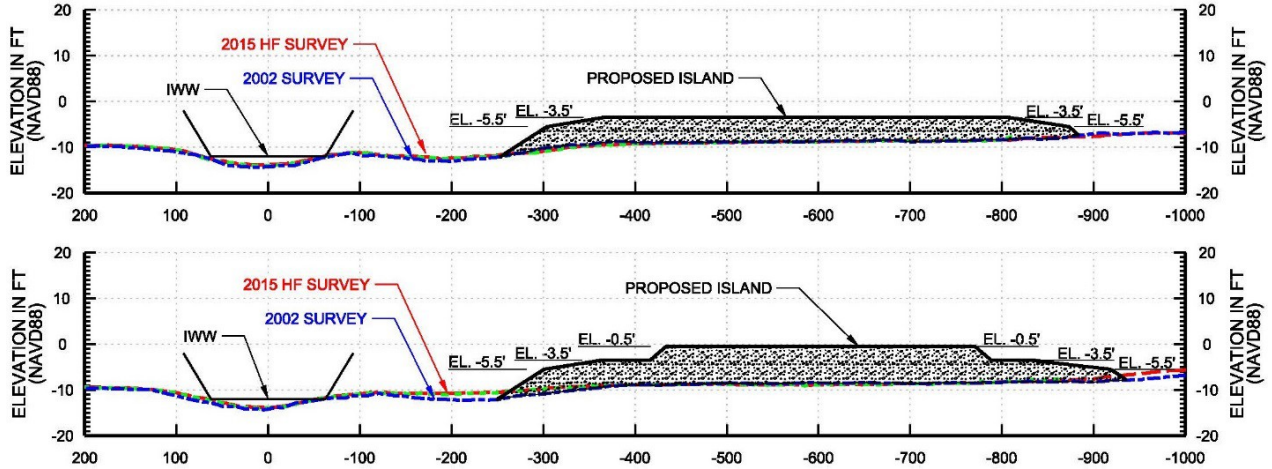


Figure 4- 4. Typical cross section of the Recommended Plan.

4.2.1 PLAN IMPLEMENTATION REQUIREMENTS

NON-FEDERAL RESPONSIBILITIES

The non-federal sponsor for the project is Palm Beach County. The non-federal project sponsor will provide an up-front cash contribution for the construction costs of the proposed project. The non-federal sponsor shall provide lands, easements, and rights-of-way, and bear a portion of the administrative costs associated with land requirements. The non-federal project sponsor will be responsible for all costs related to operation, maintenance, repair, rehabilitation, and replacement of project features.

FEDERAL RESPONSIBILITIES

USACE is responsible for budgeting for the Federal share of future Federal construction projects. Federal funding is subject to the budgetary constraints inherent in the formation of the national civil works budget in a given fiscal year. USACE would perform the necessary preconstruction engineering and design (PED) needed prior to construction. USACE would obtain water quality certification, coordinate with the state as required by the Coastal Zone Management Act, and construct the project. Cost sharing of PED and construction are subject to the availability of appropriations.

WORK-IN-KIND

The Non-Federal Sponsor has exhibited the capability, with prior participation in CAP Section 1135 projects that were completed in conjunction with the Jacksonville District, U.S. Army Corps of Engineers, to accomplish the defined work-in-kind shown in the Project Management Plan (PMP). The non-federal Sponsor will coordinate with the appropriate technical staff in order to ensure proper crediting for work-in-kind submitted.

The work-in-kind to be completed by the Non-Federal Sponsor, Palm Beach County (PBC), includes the following:

- Technical scopes of work (joint with USACE)
- Federal interest refinement (joint with USACE)
- Flows and monitoring data
- Sediment analysis and benthic mapping
- Surveys
- Cultural surveys
- Geotechnical data
- Alternatives identification and evaluation (joint with USACE)
- Design (joint with USACE)
- Coordination of C&SF historical data with SFWMD
- Permits

PROJECT PARTNERSHIP AGREEMENT

The Project Partnership Agreement (PPA) remains to be developed.

SPONSOR'S VIEWS

The sponsor is in full support of the Recommended Plan and does not wish to pursue a Locally Preferred Plan.

REAL ESTATE REQUIREMENTS

The construction activities as proposed are within the navigable waters of the United States and available to the Federal Government by navigation servitude. The borrow area identified for the project is located on Peanut Island and is approximately 11.8 miles north of the project area. The borrow area will be available via a borrow easement from the non-federal sponsor. Access to the borrow area will take place from the water's edge to the borrow area via a road easement from the non-federal sponsor. A staging area will be available via a temporary work area easement from the non-federal sponsor. Refer to (Figure 4-5).



Figure 4- 5. Real estate requirements.

PERMITS

This project will be performed in compliance with the state of Florida’s water quality standards. An application for a water quality certification will be submitted to the state’s Department of Environmental Protection (DEP). This project qualifies for the sovereignty submerged lands management “General Permit to U.S. Army Corps of Engineers for Environmental Restoration or Enhancement Activities” (F.A.C. 62-330.630). In compliance with the Coastal Zone Management Act (CZMA), a Federal Consistency Determination (FCD) is included in Appendix D-2 (CZMA). A copy of the state of Florida’s preliminary concurrence with the FCD was received on April 10, 2017 and is included in Appendix D-2 (CZMA). All permits and approvals will be obtained prior to the start of construction.

MONITORING AND ADAPTIVE MANAGEMENT PLAN

A Monitoring and Adaptive Management Plan was developed to ensure and measure the success of the project and dictate the direction adaptive management should proceed, if needed. The Monitoring and Adaptive Management Plan can be reviewed in Appendix E (Monitoring and Adaptive Management Plan) of this report. Although the material used from the DMMA is suitable, the method of sand capping will result in a flat slope. The seagrass habitat created may not adapt to rising sea levels without additional material being placed on top of the existing substrate.

4.3 DETAILED COST ESTIMATE AND COST APPORTIONMENT

A detailed cost estimate is provided in the Cost Engineering Appendix. These costs are more developed and will vary from those shown in Chapter 2, which were planning level costs. Table 4-2 shows a cost summary, and Table 4-3 details the Federal and non-federal cost apportionment.

Table 4- 2. Project First Costs Recommended Plan cost summary (FY18 price levels).

Lake Worth Lagoon CAP Section (1135) Summary of Project Cost (FY18 Price Levels)	
Item	Project First Cost
Construction	\$10,201,000
Adaptive Assessment	\$158,000
PED	\$788,000
Construction Management	\$741,000
Real Estate	\$84,000
TOTAL	\$11,973,000
*costs include contingency	

Table 4- 3. Cost sharing of the Recommended Plan (FY18 price levels).

Lake Worth Lagoon CAP 1135 Summary of Project Cost Sharing (FY18 Price Levels)					
Item	Federal Cost	Federal %	Non-Federal Cost	Non-Federal %	Project First Cost
Cash Contribution	\$8,979,750		\$2,951,250		\$11,931,000
LERRD	-		\$42,000		\$42,000
In-Kind Contribution	-		-		-
Implementation Cost	\$8,979,750	75%	\$2,993,250	25%	\$11,973,000

4.4 RISK AND UNCERTAINTY

Even with implementation of the Recommended Plan, residual risk remains. The Recommended Plan addresses creation of habitat that will withstand current environmental conditions in Lake Worth Lagoon that are detrimental to seagrass and oyster habitat. It is not designed to prevent freshwater discharges with resultant salinity and sediment accumulation impacts, however, the Snook Islands restoration project

is located closer to the S-155 freshwater discharges than the proposed Bonefish and El Cid locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species which indicates that the influence of S-155 on the selected site will be minimal. The project is also susceptible to sea level rise over the life of the project. The solution recommended will be adaptable to overcome those remaining risk conditions.

4.5 SEA LEVEL CHANGE CONSIDERATIONS

The regional sea level rise predicted by the three scenarios (baseline, intermediate, and high) at the end of the 50 year life of the project were projected to be 0.39 ft., 0.85 ft, and 2.32 ft, respectively. While sea level rise can reduce the acreage of habitat created by this project, the uncertainty in sea level rise rates will only impact the relatively small habitat acreage of the project. Seagrasses are found in LWL in water depths up to 12 feet, and are therefore expected to continue to exist within their current range, although photosynthetic efficiency may decrease with increasing depth. There are no risks to life safety, property, or critical infrastructure due to the project in the event of higher than expected sea level rise rates.

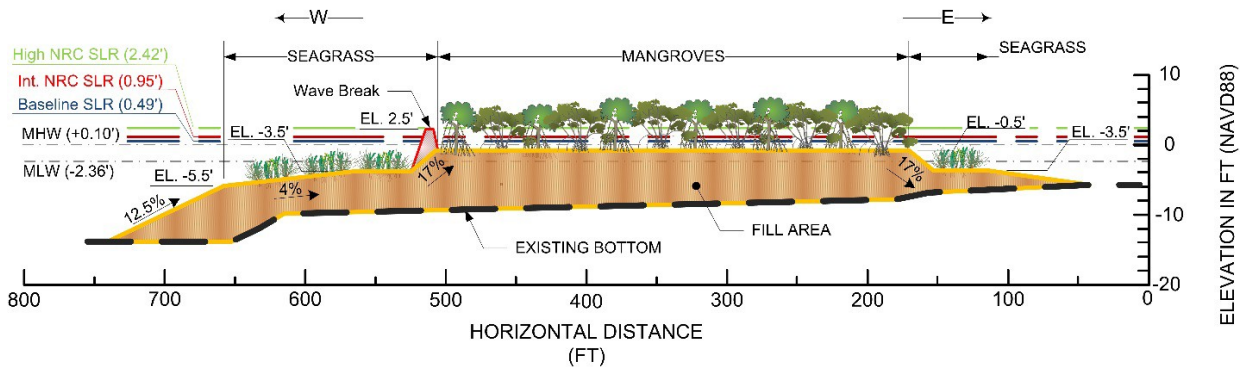


Figure 4- 6. Cross section of the Recommended Plan with sea level rise scenarios. 0.10' has been added to the baseline (0.39'), intermediate (0.85'), and high (2.32') SLR scenarios to account for Mean High Water (MHW).

Qualitative Analysis of Impacted Resources

This study area is located within the horizontal and vertical extents bounded by the 100-yr high rate curve of SLC impacts. The 100-yr high rate curve SLC of 6.5 ft, impacts about 8,000 acres adjacent to the Lake Worth Lagoon, based on 2006 and 2009 Florida Department of Emergency Management coastal lidar data. Potential impacts of rising sea level include overtopping of waterside structures, increased shoreline erosion, and flooding of low lying areas. A positive potential impact of sea level rise on the project is a reduction in required maintenance due to increased depth in the channel. Table 4-3 describes the qualitative analysis for critical resources within and surrounding the project area.

While there is expected to be a small increase in tidal surge and penetration for all three scenarios, the structural aspects of the project will be either unaffected or can be easily adapted to accommodate the change. The primary strategy for project adaptation to maintain some level of functioning habitat is to add fill to the island's submerged and inter-tidal areas at a rate similar to the rate of sea level rise. Any investigation, design, and construction of such adaptations would be the responsibility of the non-federal sponsor.

Table 4- 4. Qualitative inventory of critical resources in the Lake Worth Lagoon study area.

Critical Resources in Study Area	Density of Resource	Relevant Notes	Risk from Sea Level Rise*
Residential structures	3	Several medium to high density areas throughout the lagoon and some portions of evacuation routes	3
Commercial structures	3	Numerous commercial facilities affected (marinas, businesses).	2
Environment and habitat	2	Saltwater marshes, mangrove and sea grass beds are located throughout the lagoon within the project area. Potential habitat areas for several endangered or protected species are within the project area.	3
Ports and navigation structures	2	Ports with cargo shipments that vary from commercial commodities to industrial goods and wastes are within the project area. The majority are located on the east shore of Lake Worth Lagoon adjacent to the inlet. USACE jetty structures are located at the channel mouth of Lake Worth Inlet.	1
Infrastructure (roads, water/sewer lines, boardwalks, railroads, airports)	3	Storm water control structures associated with canals (C-17,C-16 & C51) face potential risk. Several roadways, including county roads and State Highways 703, 704, and A1A, are located within the project area. Majority of boardwalks and/or piers found in the bay area are at risk of inundation.	3
Critical facilities (police, fire, schools, hospitals, nursing homes)	1	At least six school parcels, several fire and police facilities and two health facilities located in a potential (low-lying) area.	3
Evacuation routes	1	Inundation occurs along a 3.5 miles section of Sate Highway A1A, 703 on Singer Island and portions of A1A, South Ocean Blvd in Palm Beach Island. Local roadways located in low-lying residential areas.	2
Recreation	3	Large areas of beach recreation. Three golf courses. Fishing piers, both private and commercial.	3

*3=high, 2=medium, 1=low

5 ENVIRONMENTAL COMPLIANCE

5.1 NEPA SCOPING AND PUBLIC MEETINGS

A scoping letter was submitted in October 2016 inviting the participation of all Federal and state agencies, appropriate federally recognized tribes, and interested parties and individuals to provide comments and identify any issues or concerns on the project. No comments were received.

The Non-Federal Sponsor (NFS), Palm Beach County, met with mayor, town manager, and town engineer in December 2016 and January 2017 to discuss the proposed project. The town representatives were supportive of the project and advised meeting with the Citizens Association, presidents of the condo associations. The NFS met with the Citizens Association in January 2017, who were also supportive of the project. On February 15, 2017, the NFS met with condo associations with property fronting the project. The project was well received again. No negative comments from the Town or its residents were received by the NFS or the Corps.

5.2 STATE AND FEDERAL AGENCY COORDINATION

The proposed project was coordinated with the following agencies: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Florida State Clearinghouse, Florida State Historic Preservation Officer, Florida Fish and Wildlife Conservation Commission, and the Florida Department of Environmental Protection. All agency coordination letters are included in Appendix D (Environmental).

Consistent with USACE NEPA regulations and guidance, a Notice of Availability (NOA) of the draft EA/FONSI was issued to the public for review and comment. The NOA, which included links to the draft integrated feasibility report and environmental assessment and associated appendices, was posted to the Corps website on February 24, 2017 and distributed to the list of recipients in Table 5-1 for review and comment. Comments received during the public and agency review period are included in Appendix D-5 (Public and Agency Comments and Corps’ Responses).

5.3 LIST OF RECIPIENTS

Consistent with NEPA regulations and guidance, a NOA of the draft report and Finding of No Significant Impact (FONSI) was distributed to the following list of recipients:

Table 5- 1. Distribution list for this study (continued on next page).

1000 Friends of Florida	Advisory Council on Historic Preservation
Audubon of Florida	Bureau of Indian Affairs
Center for Environmental Health	Defenders of Wildlife
Department of the Interior	Everglades Coordinating Council
Everglades Foundation	Everglades Law Center
Federal Emergency Management Agency	Federal Maritime Commission
Federal Maritime Commission	Fish and Wildlife Foundation of Florida

Florida Atlantic University	Florida Department of Agriculture and Consumer Service
Florida Department of Environmental Protection	Florida Department of Transportation
Florida Division of Historical Resources	Florida Fish and Wildlife Conservation Commission
Florida State Clearinghouse, FDEP	Florida Wildlife Federation
Martin County Commissioners	Miccosukee Tribe of Indians of Florida
National Center for Environmental Health	National Park Service
National Parks Conservation Association	NOAA/National Marine Fisheries Service
Office of Environmental Compliance	Office of Everglades Restoration Initiatives DOI
Palm Beach County	Seminole Tribe of Florida
Sierra Club	South Florida Regional Planning Council
South Florida Water Management District	Tropical Audubon Society Inc.
U. S. Department of Justice	U.S. Department of Agriculture - NRCS
U.S. Department of Commerce	U.S. Department of Housing and Urban Development
U.S. Department of Justice	U.S. DOI Office of Environmental Policy and Compliance
U.S. Environmental Protection Agency - Region 4	U.S. Fish & Wildlife Service
U.S. Geological Survey	

A complete distribution list, including addresses, is included Appendix D-3 (Distribution List).

5.4 COMMENTS RECEIVED AND RESPONSE

Per NEPA regulations, environmental information is made available to public officials and citizens before decisions are made and before actions are taken (40 CFR 1500.1(b)). NEPA requires agencies to make diligent efforts to involve the public in preparing and implementing NEPA procedures (40 CFR 1506.6(a)) and provide a public notice of the availability of environmental documents to inform persons and agencies who may be interested or affected by the Federal action (40 CFR 1506.6(a-b)).

A public and agency review and comment period for the Lake Worth Lagoon CAP 1135 draft IFR/EA started February 24, 2017 and ended April 25, 2017. Comments received under the comment period, and USACE responses, are included in Appendix D-5 (Public and Agency Comments and Corps’ Responses).

5.5 ENVIRONMENTAL COMMITMENTS

USACE, and its contractors commit to avoiding, minimizing, or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications:

PROTECTION OF MANATEES DURING ALL IN-WATER CONSTRUCTION ACTIVITIES

USACE shall incorporate the standard manatee protection construction conditions into the plans and specifications for this project.

PROTECTION OF ALL MARINE MAMMALS (MANATEES AND DOLPHINS) DURING SEAWALL CONSTRUCTION ACTIVITIES

USACE will utilize a shutdown zone which will always be a minimum of 15 meters (50 feet) around the work area. For impact pile driving, which generates impulsive sound, a larger 40 meter (130 foot) shutdown zone shall be implemented for marine mammals only; the standard shutdown zone will continue to be applied for all other protected species. If a manatee or bottlenose dolphin approaches or

enters a shutdown zone during any in-water work, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.

PROTECTION OF SEA TURTLES AND SMALLTOOTH SAWFISH

USACE shall incorporate NMFS' "Sea Turtle and Smalltooth Sawfish Construction Conditions" into the plans and specifications for this project. USACE will utilize a shutdown zone, which will always be a minimum of 15 meters (50 feet) around the work area. If a sea turtle or smalltooth sawfish is observed approaching or entering a shutdown zone during any in-water work, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.

5.6 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) of 1969

Environmental information on the project has been compiled and this integrated report has been prepared. A Notice of Availability for the integrated report/FONSI was distributed to interested stakeholders for review and comment on February 24, 2017. The project is in compliance with the National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321, *et seq.* P.L. 91-190.

CLEAN AIR ACT of 1972

The project is located in the Air Quality Control Region (AQCR) known as Southeast Florida Intrastate AQCR. The project area is in attainment for all the National Ambient Air Quality Standards (NAAQS). The project will not create any new sources of air pollution and it will be performed in compliance with the state of Florida's air quality standards. This project is in compliance with the Act.

CLEAN WATER ACT of 1972

The project will be in compliance with this Act. Application for Section 401 water quality certification will be made to the Florida DEP prior to construction during the design and implementation phase of the project. All state water quality standards will be met. A Section 404 (b)(1) evaluation is included in this report as Appendix D-1 (404(b)(1)).

COASTAL BARRIER RESOURCES ACT and COASTAL BARRIER IMPROVEMENT ACT of 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These Acts are not applicable.

COASTAL ZONE MANAGEMENT ACT of 1972

A FCD, in accordance with 15 C.F.R. 930 Subpart C, is included in this report as Appendix D-2 (CZMA). In an email dated, April 10, 2017, "...the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes." Coordination documents for the Act are included in this report under Appendix D-2 (CZMA).

ESTUARY PROTECTION ACT of 1968

No designated estuary will be affected by project activities. This Act is not applicable.

FARMLAND PROTECTION POLICY ACT of 1981

No prime or unique farmland would be impacted by implementation of this project. This Act is not applicable.

RIVERS AND HARBORS ACT of 1899

The proposed work will not obstruct the navigable waters of the United States. The proposed action will be subject to public notice and other evaluations normally conducted for activities subject to the Act. The project is in full compliance.

SUBMERGED LANDS ACT of 1953

The project will occur on the submerged lands of the State of Florida. This project qualifies for the sovereignty submerged lands management “General Permit to U.S. Army Corps of Engineers for Environmental Restoration or Enhancement Activities” (F.A.C. 62-330.630). By coordination of the project through the Interagency Coordination Agreement between the Florida DEP and USACE, Jacksonville and Mobile Districts (2006), the State will be engaged and this project will be in compliance with the Act.

WILD AND SCENIC RIVER ACT of 1968

No designated Wild and Scenic river reaches would be affected by project related activities. This act is not applicable.

ENDANGERED SPECIES ACT of 1973

Pursuant to Section 7 of the Act, coordination was conducted with NMFS and USFWS. The Corps will comply with all substantive and procedural requirements of the Act before and during construction. USACE has concluded the project “may affect, but is not likely adversely affect” the following listed species: Smalltooth Sawfish (*Pristis pectinata*), Johnson’s Seagrass (*Halophila johnsonii*), West Indian (Florida) Manatee (*Trichechus manatus latirostris*), Loggerhead Sea Turtle (*Caretta caretta*), Green Sea Turtle (*Chelonia mydas*), Hawksbill Sea Turtle (*Eretmochelys imbricate*), Leatherback Sea Turtle (*Dermochelys coriacea*), and migratory birds. This project will not affect DCH. Coordination under Section 7 of the ESA with the UWFWS and NMFS was initiated on January 20, 2017. A copy of the USFWS Section 7 ESA concurrence letter was received on March 15, 2017. A copy of the NMFS Section 7 concurrence letter was received on August 18, 2017. Coordination documents for this project are located in Appendix D (Environmental). This project is in compliance with the Act.

FISH & WILDLIFE COORDINATION ACT of 1958

A Memorandum of Agreement was signed by the Corps and USFWS on March 23, 2017 agreeing to utilize the NEPA review and ESA consultation process to complete coordination responsibilities under the Fish and Wildlife Coordination Act to avoid duplicate analysis and documentation efforts. This project was coordinated with the USFWS and is in compliance with the Act. Coordination documents are included in Appendix D (Environmental).

MIGRATORY BIRD TREATY ACT and MIGRATORY BIRD CONSERVATION ACT

No migratory birds will be affected by project activities. The project was coordinated with USFWS and is in compliance with these Acts.

MAGNUSON-STEVENSON FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

An EFH assessment is included within this integrated report. This project is in compliance with the Act. The Corps concluded consultation with NMFS under the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act. NMFS Habitat Conservation Division provided four conservation recommendations on April 25, 2017 with the Corps providing responses on June 16, 2017, concluding consultation.

ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project was coordinated with NMFS and is in compliance with the Act.

MARINE MAMMAL PROTECTION ACT of 1972

There is no anticipated take of any marine mammal during any activities associated with the project. Appropriate actions will be taken to avoid listed and protected marine mammal species effects during project construction. If a marine mammal is identified within the project boundaries, cease work requirements will be implemented until the animal leaves the project area of its own volition, preventing potential take of the animal under the MMPA. As a result of this, the project will be in compliance with the Act.

MARINE PROTECTION, RESEARCH and SANCTUARIES ACT (OCEAN DUMPING ACT)

Ocean disposal is not a component of this project; therefore, this Act is not applicable.

NATIONAL HISTORIC PRESERVATION ACT of 1966 (INTER ALIA)

Consultation with the Florida SHPO was initiated on August 30, 2016 in accordance with the National Historic Preservation Act of 1966, as amended, and as part of the requirements and consultation processes contained within the NHPA implementing regulations of 36 C.F.R. 800. This project shall be in compliance with the Archeological Resources Protection Act (P.L. 96-95), the Abandoned Shipwreck Act of 1987 (P.L. 100-298; 43 U.S.C. 2101-2106), American Indian Religious Freedom Act (P.L. 95-341), Executive Orders (E.O.) 11593, 13007, & 13175, and the Presidential Memo of 1994 on Government to Government Relations. The Florida Department of State, State Historic Preservation Officer reviewed the project, and by letter dated September 26, 2016 found that “proposed project is unlikely to adversely affect historic properties” within the previously surveyed Currie Park and El Cid project areas; however, Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove require submerged remote sensing cultural resource assessment surveys. A copy of this letter is included in Appendix D. In a letter (DHR No. 2016-3626-B) dated June 2, 2017, USACE received concurrence from SHPO that the project will have no effect on historic properties eligible for inclusion in the NRHP. Consultation with the appropriate federally recognized Tribes and other interested parties is complete. The Recommended Plan will be in compliance with the goals of this Act upon completion of coordination of the undertaking.

UNIFORM RELOCATION ASSISTANCE AND REAL PROPERTY ACQUISITION POLICIES ACT OF 1970.

The project does not involve real property acquisition and/or displacement of property owners or tenants. The Act is not applicable to this project.

EXECUTIVE ORDER (E.O.) 11988, FLOOD PLAIN MANAGEMENT

The project has been evaluated in accordance with this E.O. The project is in compliance.

LAKE WORTH LAGOON 1135 CAP PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

E.O. 11990, PROTECTION of WETLANDS

No wetlands will be affected by project activities. This project is in compliance with this EO.

E.O. 12898, ENVIRONMENTAL JUSTICE

This environmental justice assessment recognizes the issues addressed in the Environmental Justice Guidance under NEPA (CEQ 1997), and uses EPA Guidance for Incorporating Environmental Justice Concerns in USEPA's NEPA Compliance Analyses (USEPA 1998) as a guide.

An environmental justice assessment requires an analysis of whether minority and low-income populations (i.e. "the populations of concern") would be affected by a proposed Federal action and whether they would experience adverse impacts from the proposed action at any of the site alternatives. If there are adverse impacts, the severity and proportionality of these impacts on populations of concern must be assessed in comparison to the larger non-minority or non-low-income populations. At issue is whether such adverse impacts fall disproportionately on minority and/or low-income members of the community and, if so, whether they meet the threshold of "disproportionately high and adverse." If disproportionately high and adverse effects are evident, then USEPA guidance advises that it should trigger consideration of alternatives and mitigation actions in coordination with extensive community outreach efforts (USEPA 1998).

The proposed action will not result in adverse human health or environmental effects which would disproportionately impact a particular minority or low-income population. This project is in compliance with this E.O.

E.O. 13045, DISPARATE RISKS INVOLVING CHILDREN

This EO mandates that each Federal agency make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

As the proposed action does not affect children disproportionately from other members of the population, the proposed action would not increase environmental health or safety risks to children. This project is in compliance with this E.O.

E.O. 13089, CORAL REEF PROTECTION

This EO may apply to coastal projects, especially those which might directly or indirectly impact coral reefs. There are no corals in the project footprint; therefore, this E.O. is not applicable.

E.O. 13112, INVASIVE SPECIES

The proposed action will require the mobilization of dredge equipment that could possibly come from other geographical regions in the United States. Dredge equipment has the potential to transport species from one region to another, introducing them to new habitats where they are able to out-compete native species. The specifications for the construction contract will include measures to avoid or limit the risks of introducing non-native species.

6 RECOMMENDATIONS

I have given consideration to all significant aspects in the overall public interest, including engineering feasibility, economic, social, cost and risk analysis, and environmental effects. The Recommended Plan described in this final report provides the optimum solution for ecosystem restoration within the study area that can be developed with the framework of the formulation concepts. Implementation of the Recommended Plan for the Lake Worth Lagoon 1135 Project is recommended at this time, with such modification as the discretion of the Commander, South Atlantic Division, U.S. Army Corps of Engineers (SAD), deems advisable.

The Recommended Plan is Alternative 1B: Island Creation at Bonefish Cove. Restoration activities include creation of small mangrove islands by filling dredge holes, placement of a thin layer of sand on muck sediment to create seagrass habitat, and the placement of prefabricated reef modules for the creation of oyster reef habitat. The plan will provide an ecosystem solution that maximizes sustainable habitat for marine ecosystem flora and fauna within Lake Worth Lagoon over the project life and minimizes damage from muck and freshwater flows.

6.1 DRAFT ITEMS OF LOCAL COOPERATION

Recommendations for provision of Federal participation in the Recommended Plan described in this report would require the project sponsor to enter into a written PPA, as required by Section 221 of Public Law 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army. Such local cooperation shall provide the following non-federal responsibilities:

- a. Provide 25 percent of the total project cost as further specified below:
 1. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material as determined by the Federal Government to be required or to be necessary for the construction, operation, and maintenance of the project;
 2. Provide, during construction, any additional contributions necessary to make its total contribution equal to 25 percent of total project costs;
- b. Provide, during construction, 100 percent of any project costs that exceed the federal limit of \$10,000,000;
- c. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal sponsor's obligations for the project unless the Federal agency providing the funds verifies in writing that such funds are authorized to be used to carry out the project;

- d. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the project, hinder operation and maintenance of the project, or interfere with the project's proper function;
- e. Shall not use project lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;
- f. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4601-4655) and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;
- g. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;
- h. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;
- i. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;
- j. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local Governments at 32 CFR, Section 33.20;
- k. Comply with all applicable Federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the

Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

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

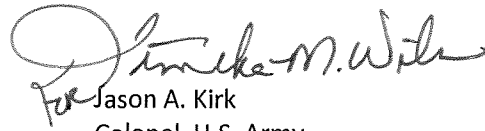
m. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, rehabilitation, or replacement of the project;

n. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA;

o. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 99-662, as amended, (33 U.S.C. 2211(e)) which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

6.2 DISCLAIMER

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for project modification and/or implementation funding. The recommendations herein for provision of CAP Section 1135 project for the Lake Worth Lagoon do not include any provisions for work which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in past years for this project for purposes prohibited by this Act.



For Jason A. Kirk
Colonel, U.S. Army
District Engineer

7 ACRONYMS, INDEX, AND REFERENCES

7.1 ACRONYMS

AQCR: Air Quality Control Region
C&SF: Central and South Florida Project
CAP: Continuing Authorities Program
cfs: cubic feet per second
CZMA: Coastal Zone Management Act
DCH: Designated Critical Habitat
DEP: Department of Environmental Protection
DMMA: Dredge Material Management Area
EFH: Essential Fish Habitat
EO: Executive Order
EOPs: Environmental Operating Principles
EPA: Environmental Protection Agency
ESA: Endangered Species Act of 1973
EX: existing conditions
FCD: Federal Consistency Determination
FCMP: Florida Coastal Management Program
FCSA: Feasibility Cost Sharing Agreement
FEB: Flow Equalization Basin
FID: Federal Interest Determination
FMSF: Florida Master Site File
FONSI: Finding of No Significant Impact
ft: feet
FWO: future without project
FWP: future with project
GHG: greenhouse gases
HAPC: Habitat of Particular Concern
HEP: Habitat Evaluation Procedures
HSI: Habitat Suitability Indices
HU: habitat units
IWW: Intracoastal Waterway
LPP: Locally Preferred Plan
LWL: Lake Worth Lagoon
MANLAA: may affect, but is not likely to adversely affect
MCACES: micro-computer aided cost estimating system
MMPA: Marine Mammal Protection Act of 1972
NAAQS: National Ambient Air Quality Standards
NED: National Economic Development
NEPA: National Environmental Policy Act
NER: National Environmental Restoration
NFS: Non-federal sponsor

CHAPTER 7.0 Acronyms, Index, and References

NHPA: National Historic Preservation Act
NLCD: National Land Cover Database NMFS:
National Marine Fisheries Service NOA:
Notice of Availability
NRHP: National Registry of Historic Properties
PBHNP: Palm Beach Harbor Navigation Project
PDT: Project Delivery Team
ppt: parts per thousand
S&A: Supervision and Administration
S&I: Supervision
SAV: Submerged Aquatic Vegetation
SFWMD: South Florida Water Management District
SHPO: State Historic Preservation Office
STA: Stormwater Treatment Areas TAR:
Tidewater Atlantic Research, Inc.
USACE: United States Army Corps of Engineers
USFWS: United States Fish and Wildlife Service
WRDA: Water Resource Developmental Act

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**Continuing Authorities Program
Section 1135 Project**

Engineering Appendix

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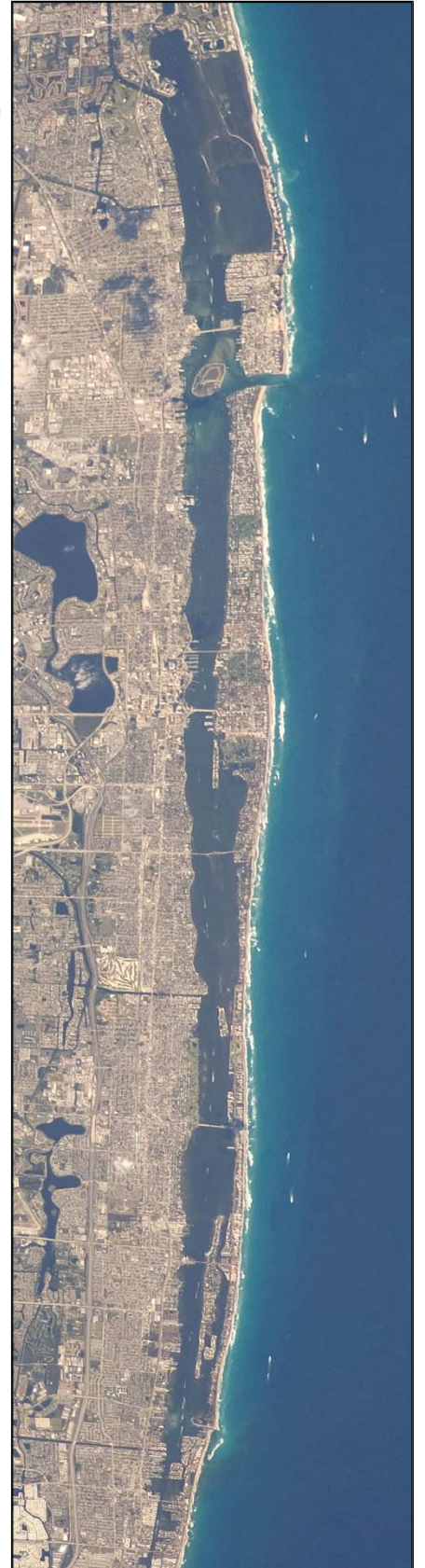
**Lake Worth Lagoon
Ecosystem Restoration Project**

West Palm Beach, Florida

November 2016



**US Army Corps
of Engineers**®
Jacksonville District



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Attachment B – Lake Worth Lagoon Watershed

Attachment C – Lake Worth Lagoon Past Projects

Attachment D – Peanut Island Phase I ESA

Attachment E – Geotechnical Data

Attachment F – Past Permits

List of Acronyms

ACES	Automated Coastal Engineering System
ac-ft	Acre-feet
ADCP	Acoustic Doppler current profiler
ASTM	American Society of Testing and Materials
C&SF	Central and South Florida
CAP	Continuing Authorities Program
Corps	United States Army Corps of Engineers
cfs	Cubic feet per second
cy/s	Cubic Yard(s)
DBHYDRO	SFWMD hydrologic database
DERM	Department of Environmental Resources Management
D&I	Design and Implementation
DMMA	Dredged Material Management Area
ER	Engineering Regulation
ETL	Engineering Technical Letter
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FIND	Florida Inland Navigation District
GHCN	Global Historical Climatology Network
IWW	Intracoastal Waterway
LS	Lump Sum
LWL	Lake Worth Lagoon
MHHW	Mean Higher-High Water
MHW	Mean High Water
MLLW	Mean Lower-Low Water
MLW	Mean Low Water
mph	miles per hour

MSC	Major Subordinate Command
MSL	Mean Sea Level
MTL	Mean Tide Level
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum 1928
NOAA	National Oceanic and Atmospheric Administration
PBC	Palm Beach County
PBHNP	Palm Beach Harbor Navigation Project
PDT	Project Delivery Team
POR	Period of Record
psu	Practical salinity unit
ROM	Rough Order of Magnitude
RSL	Relative Sea Level
SFWMD	South Florida Water Management District
SLC	Sea Level Change
SPF	Standard Project Flood
USACE	US Army Corps of Engineers
WRDA	Water Resources Development Act

1.1 PROJECT INFORMATION

1.2 Project Title

Lake Worth Lagoon Continuing Authorities Program, Section 1135, Ecosystem Restoration Project

1.3 Project Identification Number

The P2 number for the Lake Worth Lagoon project is 447752.

1.4 Project Authorization

Lake Worth Lagoon Project is authorized under Section 1135, Project Modification for Improvement of the Environment of the Water Resources Development Act (WRDA) of 1986, 33 USC 2309a; funding and cost-sharing guidance is covered under Public Law 99-662. Section 1135 provides the authority to review the operation of water resources projects constructed and determine the need for improving the quality of the environment degraded by existing Corps projects. Section 1135 purpose is to restore the degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition considering the ecosystem's natural integrity, productivity, stability and biological diversity. This authority is primarily used for altering the hydrology in and along bodies of water, including wetlands and riparian areas. Section 1135 falls under the Continuing Authorities Program (CAP), which focuses on water resource related projects of relatively smaller scope, cost and complexity than typical USACE efforts. CAP is a delegated authority to plan, design, and construct certain types of water resource and environmental restoration projects without specific Congressional authorization. Additional Information on this program can be found in Engineering Regulation 1105-2-100, Planning Guidance Notebook, Appendix F.

1.5 Project Non-Federal Sponsor

Project Sponsor is Palm Beach County Board of Commissioners; however, the project is managed by the Palm Beach County (PBC) Department of Environmental Resources Management (DERM).

1.6 Project Setting

Lake Worth Lagoon (LWL) is on the Atlantic Coast of Florida approximately 53 miles south of Ft. Pierce Harbor, 40 miles north of Port Everglades, and 65 miles north of Miami Harbor. LWL is approximately 21 miles long, and up to a mile wide. The lagoon provides an important habitat for native plants, fish, and wildlife, and various recreational activities. LWL is separated from the Atlantic Ocean by two barrier islands, Singer Island and Palm Beach Island; the lagoon depths are generally eight feet deep. Ocean access is provided by two inlets: Lake Worth Inlet and South Lake Worth Inlet (locally known as Boynton Inlet). Lake Worth Inlet is a Federally maintained deep draft inlet and serves as an entrance to the Palm Beach Harbor. South Lake Worth Inlet is approximately 18.5 miles south of Lake Worth Inlet and was constructed in 1927 to improve circulation of the southern end of LWL. The Intracoastal Waterway (IWW) runs the entire length of the lagoon (**Figure 1-1**).

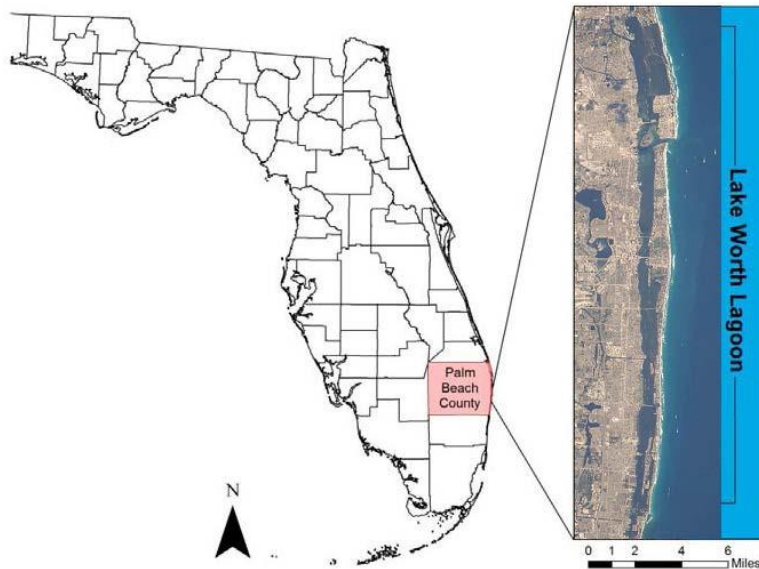


Figure 1-1 – Project Location

1.7 Project Description

Florida’s coastal lagoons and estuaries are extremely important ecosystems, as they support unique and important fish and wildlife populations, and LWL is no exception. LWL provides an inland to coastal marine-connected system where juvenile marine animals hatch before venturing into the open ocean. Coastal lagoons are typically long narrow, shallow water bodies separated from the ocean by one or more barrier islands. Coastal lagoons are connected to the ocean by

one or more inlets, and can vary in salinity between a freshwater to hypersaline. The geological, hydrological, and climatological factors which influence the conditions within LWL are numerous, complex, and interrelated. Therefore, the engineering analysis of this project is presented in this appendix in order of problem evolution: Understanding the Project Area (Chapter 2); Understanding the Problem – synthesizing the data (Chapter 3); and Fixing the Problem – determining the main source of the problem and the best way to fix it (Chapter 4). Lastly, Chapter 5 discusses the outstanding needs of the project that will be addressed by Design and Implementation (D&I) phase.

1.8 Acknowledgement

This report and its findings would not be possible without the assistance of Palm Beach County's Department of Environmental Resource Management (DERM). Their tireless efforts and commitment to the well-being of this viable resource have made this report possible.

2.1 UNDERSTANDING THE PROJECT AREA

Coastal lagoons are impacted by natural forces and anthropogenic adaptations, and LWL is no exception. To gain a better understanding of the project area, this chapter will explore on the geology of LWL, its anthropogenic changes over time, and natural forces which have influenced LWL. The features that will be discussed, namely canals (C-51, C-16, and C-17), associated flood control structures (S-155A, S-155, S-41, and S-44), LWL, Lake Worth Inlet, and Boynton Inlet are shown on **Figure 2-1**.

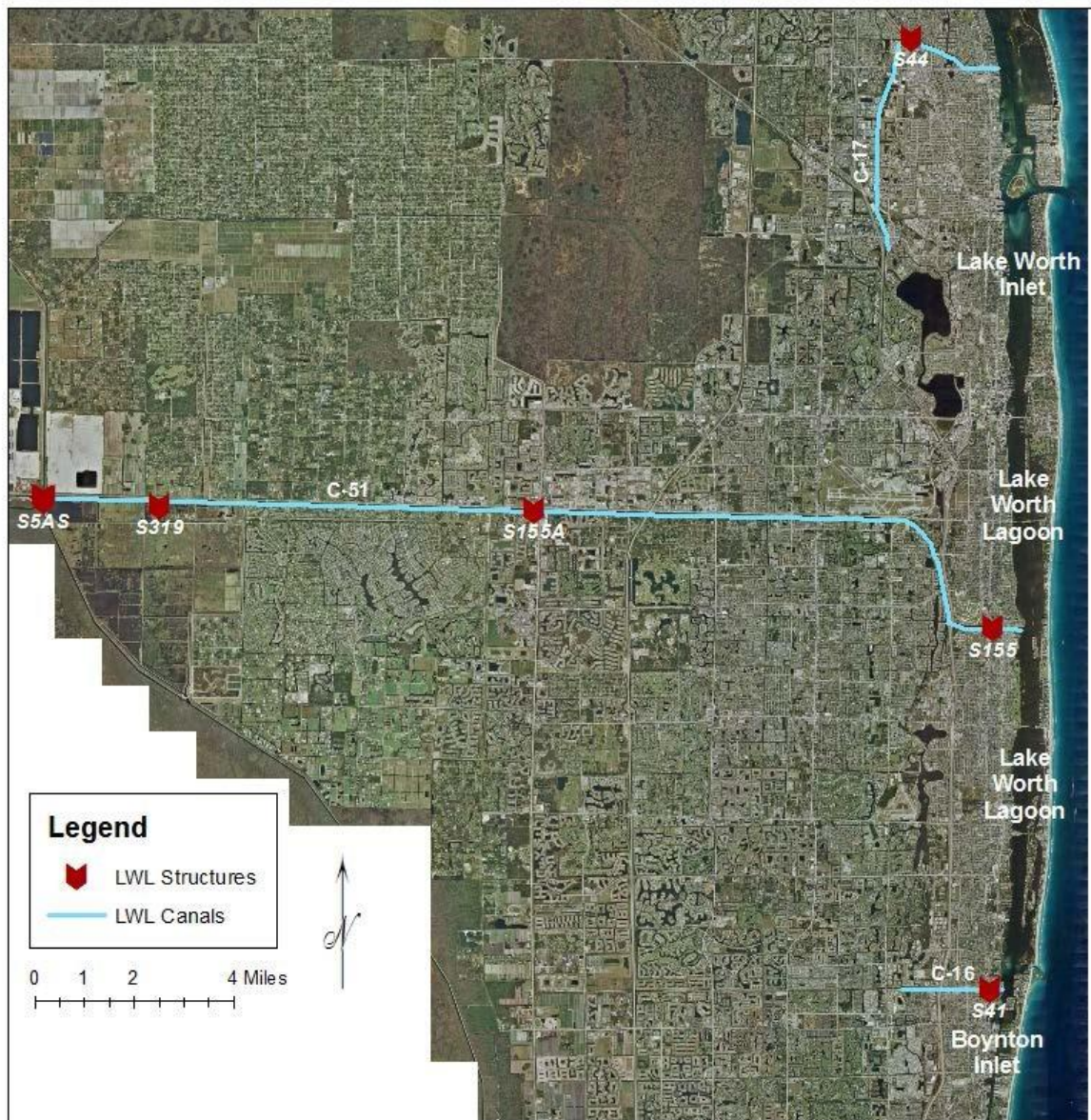


Figure 2-1 – Project Area Features

2.2 Geological

The geological history of the project area and the sequence of changes in levels of land and sea, which have resulted formation of the coastal lagoon are discussed below.

2.2.1 Regional Geology

The Florida Peninsula occupies a portion of the much larger geologic unit called the Florida Plateau. Deep water in the Gulf of Mexico is separated from deep water of the Atlantic Ocean by this partially submerged platform nearly 500 miles long and 450 miles wide. Since the Mesozoic Era, approximately 200 million years BP (before present), the plateau has been alternately dry land or covered by shallow seas. During that time up to 20,000 feet of carbonate and marine sediments were deposited in central and southern Florida. Either following or concurrent with one of the later periods of emergence, there appears to have been a tilting of the Florida Plateau about its longitudinal axis. The west coast was partially submerged, as indicated by the wide estuaries and offshore channels, while the east coast was correspondingly elevated, showing the characteristics of an emergent coastline (Randazzo and Jones, 1997).

During the last million years, a series of four glacial periods, or ice ages, brought about significant changes in sea level. As a result of these sea level fluctuations, the Florida peninsula was again covered and uncovered by shallow seas. Following the first glacial period, sea level rose 270 ft. above its present level. Dry land on the Florida peninsula was then restricted to a few small islands along the central Florida ridge and in northeast Florida. **Figure 2-2** shows the present Florida coastline with previous sea level stands, and the extent of the carbonate platform.

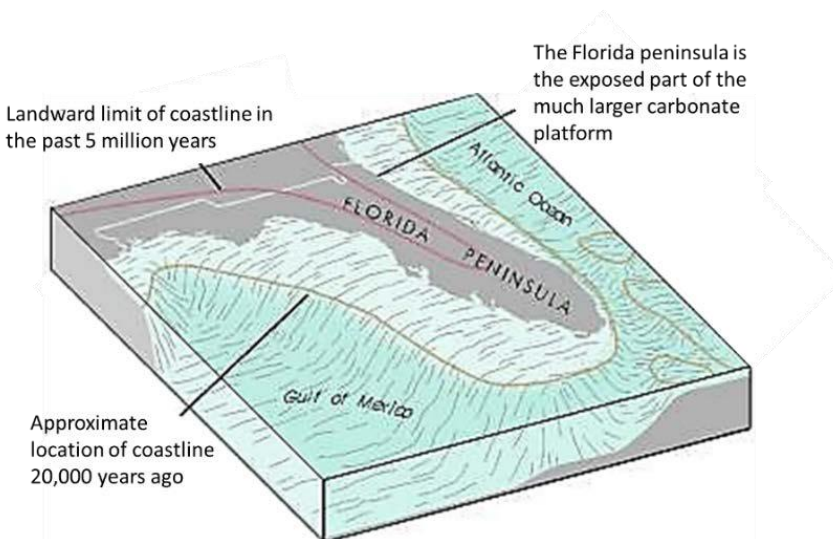


Figure 2-2 The Florida Peninsula.

About 100,000 years ago, the last glacial period began. Sea level fell to 300 feet below its present level and the Florida Plateau emerged as dry land. Approximately 15,000 years ago, sea level began its most recent rise towards present sea level (Shinn, 1988). Sea level rose at an average rate of 30 feet per 1,000 years. About 7,000

years ago, the rate of sea level rise slowed when the sea level was about 30 feet below its present level. It was at this most recent slowing of sea level rise that the modern barrier islands of southeast peninsular Florida formed.

2.2.2 Local Geology

Palm Beach County is made up of three physiographic areas: The Atlantic Coastal Ridge, the Sandy Flatlands, and the Everglades. The formations exposed at the surface include sand, coquina, and limestone deposited during the glacial epochs starting 1 to 2 million years ago.

With the exception of the Everglades and the Loxahatchee Marsh area, where organic soils cover the surface, a layer of surface sand (Pamlico sand) overlies all of Palm Beach County. On the sandy flatlands between the Everglades and the coastal ridge, this sand is one to two feet thick, increasing to 10 feet along the ridge and adjacent barrier islands.

The Anastasia Formation immediately underlies the surficial sands. This formation is composed of sand, coquina, sandstone, limestone and shell beds. The Anastasia underlies all of eastern Palm Beach County from the beaches, where it ranges from 40 to 50 feet thick, to the edge of the Everglades, where it can be up to 200 feet thick. The Everglades is underlain by the Fort Thompson Formation, which consists of marine sands, shell beds, sandstone, limestone and freshwater marl. This formation is of the same age as the Anastasia formation and ranges from 20 to 50 feet thick.

The Caloosahatchee marl underlies the Fort Thompson and Anastasia Formations, and is composed of sandy shell marl, and shelly sand with only minor amounts of sandstone and limestone. This formation can range from 30 to 110 feet in the Everglades and 230 to 330 feet in the coastal areas. Subsequent formations include the Tamiami, Hawthorne, Tampa, Suwannee limestone, Ocala Group and the Avon Park limestone.

Most of the barrier islands in Palm Beach County are founded on the Anastasia Formation. This rock formation appears at several places in the county as a submerged reef that generally parallels the shoreline. The exposed formation appears at various locations from the high water line to approximately 1,000 feet (ft) offshore. Nearshore rock outcroppings exist in the project area. The most prominent outcropping occurs near Florida Department of Environmental Protection (FDEP) coastal monitoring range monument R-18 (Jupiter, FL). A portion of this outcropping extends above mean high water, and the remainder extends into the nearshore area.

The project area is located within LWL, a part of the Atlantic coastal ridge region. The drainage basin of LWL is also of interest to the study, and this area, covering Canals C-16, C-17, and C-51, extends into the sandy flatlands. Typical substrates found within LWL range from muck/mud (nearly all silt/clay with some organics) to sand and shell.

2.3 Hydrology

The hydrology of LWL is complex, as it involves inland processes from the canals and flood control structures, and coastal processes from waves, tides, and currents. The unique hydrologic factors of LWL are discussed in the sections below.

2.3.1 Inlets

LWL was originally a 20-mile landlocked freshwater lake (Lake Worth) fed by a wetland area along its western edge, and bordered by a barrier island to the east, which separated Lake Worth from the Atlantic Ocean (**Figure 2-3**). During Lake Worth’s freshwater history, temporary connections to the Atlantic Ocean through the barrier island (inlets) occasionally formed at the north end of the lake due to extreme high tides, waves, and high lake water levels (Linehan 1980). Eventually ephemeral ocean linkages were made permanent with dredging and channel protection structures (jetties, seawalls, etc.).



Figure 2-3 Lake Worth in the 1870s-1880s when it was primarily a freshwater lake

2.3.1.1 Lake Worth Inlet

Lake Worth Inlet (also known as Palm Beach Inlet) was originally dredged to provide access to the ocean from Lake Worth. Immediately, the lake began to change from a freshwater lake to a

saltwater estuarine system. **Table 2-1** provides a historical account of the construction of Lake Worth Inlet.

Table 2.1 - Lake Worth Inlet Construction Sequence

Year	Event
1860's	August O. Lang dug a narrow trench from Lake Worth to the ocean, lowering lake levels. Had to be re-dug many times due to instabilities (Pierce 1970)
1877	Relocated trench in a rocky area 1 mile north of Lang's Inlet, called "Black Rocks" so excavated rocks could form natural jetties, hoping to create a more stable inlet (Pierce 1970, SFWMD 1977). Was still unstable, and also had to be re-dug many times.
1893, 1905	Henry Flagler financed inlet enlargement (Historical Society of Palm Beach County)
1915	Florida State Legislature chartered the Lake Worth Inlet District (later called the Port of Palm Beach District)
1917	After a public vote and a detailed survey by Isham Randolph, the inlet was re-excavated with two short jetties, in the original Lang Inlet location (Knott 1980).
1919	Channel was widened to 100 feet and dredged to 10 feet deep at low tide by local interests
1920	More robust jetties were constructed, and the channel was deepened to 12 feet by local interests (Knott 1980).
1923	Jetties were extended, and local interests further deepened the channel to 16 feet (Knott 1980).
1925-1926	All jetty construction was completed by local interests (USACE 1988). Channel was ultimately deepened to a depth of 18 feet, and 60,000 cy of rock was removed from the mouth. Dredge spoils were used to create Peanut Island.
1935-1941	Federal Government took over, adding rocks and concrete caps to the jetties, and deepening the channel to 20 feet (USACE 1988).
1948-1967	Re-dredged several times to an ultimate depth of 35 feet.
1946	USACE studies indicated erosion along 8.5 miles of shorefront south of the south jetty due to interruption of natural littoral drift.
1957-1958	A sand transfer plant was installed on the north side of the north jetty to pump sand south across the inlet for deposition on the eroded beach.
1985	USACE chinking stone to the jetties and filled with grout to prevent transport of sand through the jetty and into the inlet.
1990-1996	Sand transfer plant shut down due to transfer pipe failure.

Year	Event
1996	Sand transfer plant resumed operation after plant upgrades and pipeline replacement.

2.3.1.2 South Lake Worth Inlet

South Lake Worth Inlet (also known as Boynton Inlet or Ocean Ridge Inlet), also a man-made inlet, is located in the southern portion of LWL. The Palm Beach County Board of Commissioners manages the inlet channel and associated structures. Local residents and visitors use South Lake Worth Inlet for recreational boat access to the Atlantic Ocean. Excavation of the channel occurred in 1925 and jetties were constructed in 1927 to keep sand from entering the inlet. **Table 2-2** provides a historical construction sequence.

Table 2.2 – South Lake Worth Inlet Construction Sequence

Year	Event
1915	State of Florida approved an act to create a Special Taxing District in Palm Beach County, the South Lake Worth Inlet District
1924	USACE issued a permit to construct an inlet at South Lake Worth
1925-1927	Construction of jetties and inlet.
1932-1934	Homeowner south of inlet constructed a 2,000-ft seawall (the “McCormick Wall”) and seven support groins in an effort to reduce erosion of sand along his property. These proved to be ineffective (Caldwell 1950).
1936	Sand was being transported around north jetty and shoaling inside south LWL (Strock 1983).
1937	Sand transfer plant was constructed on the north jetty.
1942-1945	Sand transfer plant shut down due to fuel shortage during World War II.
1948	Improvements made to sand transfer plant (Strock 1983)
1953	Training wall constructed along north side of inlet in an effort to channelize sand accumulation (Strock 1983).
1948-1952	Interior dredging of shoals likely occurred during this period, according to inlet budget records (Strock 1983).
1961-1969	Dredging of interior shoals with disposal of dredge spoil on the eroded beach south of the inlet (Strock 1983).
1964	University of Florida completed a study recommending inlet improvements to decrease shoaling in LWL (University of Florida 1964).

Year	Event
1971	A spur was constructed on the north jetty (Marino and Mehta 1986).
1996	Governor Lawton Chiles abolished the taxing district, and Palm Beach County (PBC) took over operation of the sand transfer plant.
Mid- 1990's	Beer Can Island became Bird Island with an enhancement project that included exotics removal, native vegetation recruitment, and a rookery creation.
1997-1998	Groin field constructed and beach nourishment completed to address erosion due to inlet, and sand transfer plant capacity was upgraded.
2001	PBC removed a rock ledge from the inlet and created a sand trap behind the training wall.
2001, 2008	PBC performed maintenance dredging of the sand trap and parts of the IWW. Dredge sediments were deposited south of the inlet.
2009	PBC approved a contract to replace the sand transfer plan with a new one, rehab both jetties, and construct a new seawall at Bird Island.

2.3.2 Intracoastal Waterway (IWW)

During the Civil War Reconstruction Period, canal companies were given land to develop water transportation facilities; because of this, the East Coast Canal was developed. By the late 1890s, a canal began to cut across the sawgrass marshes and various ridges to connect Lake Worth to Jupiter Inlet to the north. The channel was cut 5 ft deep and made 50 ft wide and extended from Jacksonville to Miami (Vines 1970). The canal was completed in 1898, making Lake Worth part of a larger the larger Intracoastal Waterway system. Excavated materials from the construction were placed upon existing low-lying upland areas or created scattered spoil islands. In 1929, the state of Florida purchased the East Coast Canal, deeded it to the U.S. Government, and renamed to the Intracoastal Waterway (IWW).

2.3.3 Flood Control Features

Multiple local drainage districts, municipalities, and the South Florida Water Management District (SFWMD) manage the LWL watershed and stormwater drainage system. Other than the rainfall that falls directly on the LWL basin, stormwater is routed through either C-17, C-51, or C-16 canals. The construction and operations of these three canals have created unnatural point sources of freshwater into the lagoon as compared to a more evenly distributed overland flow through natural historical streams or adjoining upland areas.

The history of the major flood conveyance canals and drainage features that discharge east into LWL watershed date back to the year 1919. **Figure 2-4** depicts the LWL watershed. All the water in the watershed drains into LWL (Refer to EN Attachment B for further characterization of the LWL watershed and Land Use statistics). The State of Florida Everglades Drainage District originally started construction of the West Palm Beach Canal (C-51) beginning in 1919 and completed construction in 1929. However, as part of the Central & South Florida (C&SF) Project (1948), multiple features, structures, and improvements to the LWL watershed and the original West Palm Beach Canal were designed and constructed over the course of 60 years by the USACE and subsequently transferred to the sponsor, the SFWMD.

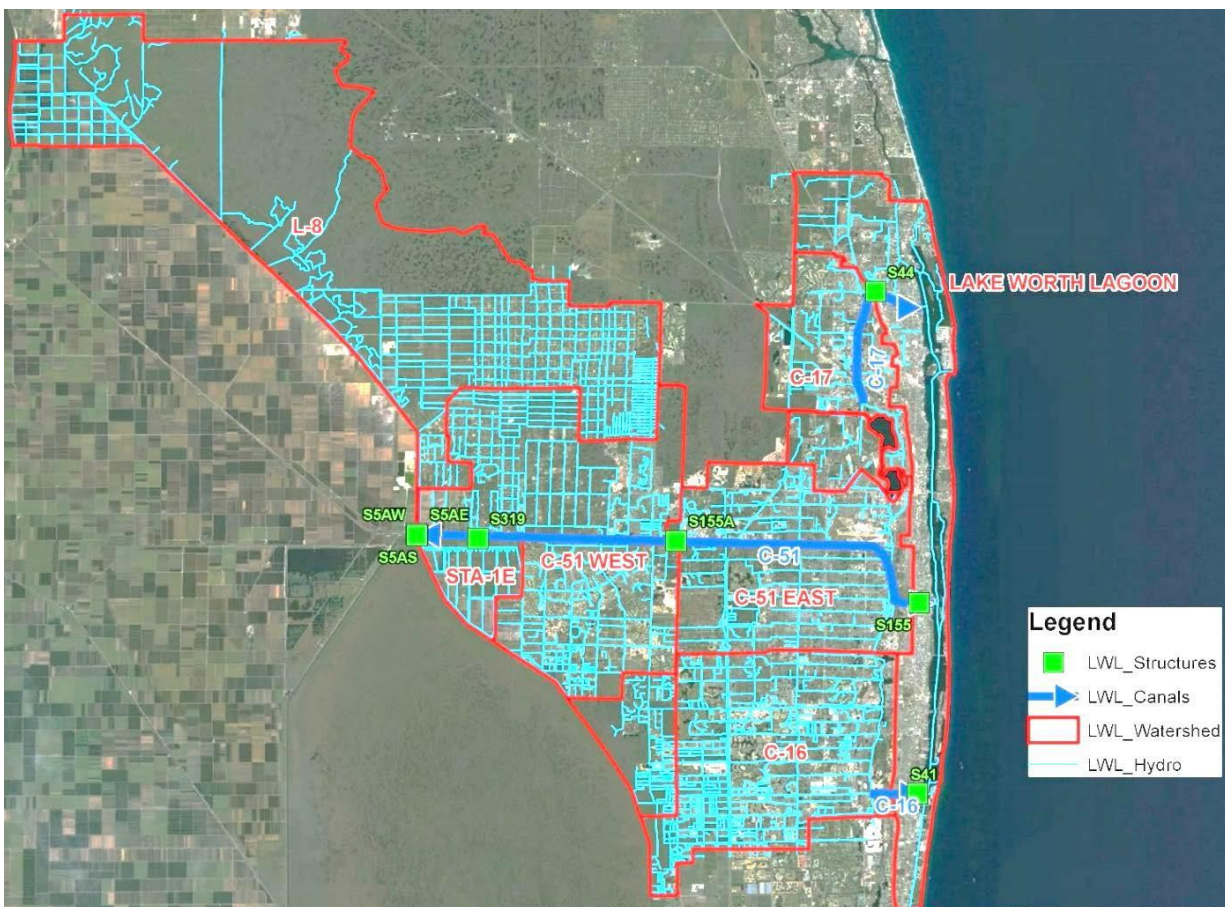


Figure 2-4 Lake Worth Lagoon Watershed.

2.3.3.1 Central & South Florida Project

The history of the major Federal features affecting freshwater discharges into the LWL are described in the following sections. The authorization of the “Central and South Florida Project for Flood Control and Other Purposes” originates from the *Flood Control Act of 1948, Section*

203 of Public Law 858, 80th Congress, 2nd Session. However, subsequent congressional authorizations following the original 1948 legislation specify individual C&SF project features for the LWL watershed (**Table 2-3**). The construction completion dates of the major features affecting the LWL are listed in **Table 2-3**. **Table 2-4** provides logistics for each of the canals that lead into LWL and includes the respective structures within Canal.

Table 2.3 - Lake Worth Lagoon Watershed Features

Feature	Authorization	Construction Completion*
C-51	Flood Control Act of 1962	NA
S-44	Flood Control Act of 1948	Feb 1957
C-17	Flood Control Act of 1948	Jan 1958
S-5AE	Flood Control Act of 1948	Apr 1955
C-16	Flood Control Act of 1954	Aug 1965
S-41	Flood Control Act of 1954	Aug 1965
S-155	Flood Control Act of 1962	Jun 1987
S-155A	Flood Control Act of 1968	Dec 2002
S-319	Flood Control Act of 1968	Mar 2004

**“C&SF Project for Flood Control and Other Purposes, Master Water Control Manual, East Coast Canals, Vol. 5, March 1995”*

Table 2.4 - Canal and Control Structures within each Canal

Canal	C-17	C-51				C-16
Length (mi.)	6.3	21.0				2.2
Level of Protection	60% SPF	30% SPF for Agricultural Areas and 60% for Urban and Citrus Areas				60% SPF
Design Water Surface (ft -NAVD88)	-0.05 to 10.5	7.0 to 11.5				0.1 to 7.5
Structure Name	S-44	S-319	S-5AE	S-155A	S-155	S-41

Canal	C-17	C-51				C-16
Structure Type	Spillway	Pump Station	Spillway	Spillway	Spillway	Spillway
Design Discharge (cfs)	2,070	3,980	700	1,460	4,800	4,500
Level of Protection	60% SPF	NA	NA	30% SPF for Agricultural Areas and 60% for Urban and Citrus Areas		60% SPF
Headwater (ft NAVD88)	7.5	9.5 to 11.0	10.0	10.0	7.0	6.6
Tailwater (ft NAVD88)	-4.6 to +2.4	NA	8.5	9.1	-2.5 to 0.5	0.3

C-17 Canal and S-44

The S-44 structure construction was completed in February 1957 (**Table 2-3**). The purpose of the C-17 canal is to drain flood waters from the low area west of the coastal ridge between Lake Mangonia and the Earman River. The C-17 canal will remove 60 percent of the standard project flood (SPF) from the drainage area. The outlet of C-17 is the S-44 spillway structure, which is designed to pass 2,070 cfs and release flood runoff from C-17 into LWL.

C-51 Canal, S-5AE, S-155, and S-155A

The C-51 canal (West Palm Beach Canal) is approximately 21 miles long with S-5AE at the headwaters of the canal in the west and by the S-155 spillway structure at the east end of the canal. Along the C-51 canal, approximately 11.2 miles upstream of S-155, is S-155A spillway structure, which separates the C-51 West basin from the C-51 East basin. Construction completion for S-5AE, S-155, and S-155A was in April 1955, June 1987, and December 2002, respectively (**Table 2-3**). The C-51 canal intercepts flows from the west, and was designed to remove 30 percent of the SPF from agricultural lands and 60 percent of the SPF from citrus and urban areas. C-51 discharges through the S-155 spillway structure into LWL to the east. The S-155A structure provides additional control of water in the C-51 canal from the C-51 West subbasin. The S-155 and S-155A spillway structures maintain optimum water levels in the C-51 canal by preventing over-drainage while simultaneously discharging flood and regulatory flows from the canal.

C-16 canal and S-41

Construction for S-41 was completed in August 1965 (**Table 2-3**). The C-16 canal (Boynton Canal) will remove 60 percent of the SPF from the drainage area. The purpose of the C-16 canal

is to provide an outlet to Lake Worth through the coastal ridge at Boynton Beach. The outlet of C-16 is the S-41 spillway structure is designed to pass 4,600 cfs (60 percent of the 5,300 SPF), to maintain desirable water stages in C-16 upstream during low-flow periods, discharge up to design capacity without exceeding desirable stages, restrict discharge during floods that will not cause damaging velocities, and prevent salt water intrusion into the canal.

2.3.4 Dredge/ Muck Holes

Common practice in the early 20th century was to dredge out portions of the lagoon and fill in low-lying areas along the LWL shoreline. These dredge holes are numerous and scattered throughout LWL, and is visible in the bathymetry data shown in **Figure 4-4**. In addition to dredging, the existing vegetative shorelines, which once inhabited the lagoon and trapped “muck” sediments, were replaced with vertical shoreline stabilization structures (i.e., bulkheads, seawalls, revetments, etc.) rather than natural wetlands or mangroves.

2.4 Climate

LWL is influenced by rainfall, local and regional winds, periodic storms, ocean tides, and water levels.

2.4.1 Rainfall

The LWL is subject to a cyclic dual season of meteorology; a wet and dry season. These seasons are defined as May to October for the wet season and November to April for the dry season. During the wet season, the LWL typically experiences frequent (often daily) brief and sometimes intense rainfall events. Additionally, the watershed is prone to Atlantic tropical cyclonic events which produce large amounts of rain over a significant area. Several of the major flooding events into the LWL were caused by these tropical events (**Table 2-5**) and observed through a nearby flood structure, S-155.

Table 2.5 - Maximum Flow Events through S-155 and Named Storms

Date	S-155 Flow (cfs)	Named Storm
16 Jan 1991	4,605.30	N/A
18 Oct. 1995	5,364.87	N/A
16 Oct. 1999	7,141.80	Hurricane Irene

Date	S-155 Flow (cfs)	Named Storm
26 Sep 2004	4,896.06	Hurricane Jeanne
27 Aug. 2012	5,057.81	Hurricane Isaac

According to the West Palm Beach International Airport (NOAA gage ID: USW00012844) from the Global Historical Climatology Network Database (GHCN), the average, maximum, and minimum annual water-year (May to April) rainfalls are 61.12, 102.90, and 32.85 inches, respectively, for the period of record 1938-2016. The wet season (May to Oct.) contains the majority of the rainfall averaging 41.97 inches and the dry season averages 19.15 inches (**Table 2-6**).

**Table 2.6 Rainfall Statistics and Seasonal Allocation at
 NOAA Gage USW00012844, West Palm Beach International Airport**

Statistic	Dry Season (Nov to April)	Wet Season (May to Oct)	Water Year (May to April)
Percent	31%	69%	100%
Average (in.)	19.15	41.97	61.12
Minimum (in.)	4.06	21.33	32.85
Maximum (in.)	42.56	75.61	102.90

2.4.2 Wind Climate

Winds influence water levels, currents, and waves in LWL. The representative station used to describe the wind climatology in the lagoon is the West Palm Beach Airport, Station PBI, which has a period of record from 1970 to the present. **Figure 2-5** shows a wind rose plot of percent occurrence of wind speed and direction for all records at station PBI. The majority of the winds are from the northeast, east, and southeast directions, and to a lesser extent from the northwest. During the months of October and November the predominate wind direction is from the northeast to east with an average wind speed of about 10 mph (8.7 knots), with more frequent occurrences of wind speeds of 15 mph (13 knots) to 20 mph (17 knots) and greater. During the months of December through February the predominate wind directions are from the east to southeast and from northwest with an average wind speed of about 10 mph (8.7 knots), with more frequent occurrences of wind speeds of 15 mph (13 knots) to 20 mph (17 knots) and

greater. During the months of March through May the predominate wind directions are from the east to southeast with an average wind speed of about 11 mph (9.6 knots), with more frequent occurrences of wind speeds of 15 mph (13 knots) to 20 mph (17 knots) and greater. During the months of June through September the predominate wind directions are from the east to southeast with an average wind speed of about 8 mph (7 knots), with more frequent occurrences of wind speeds of 10 mph (8.7 knots) to 15 mph (13 knots).

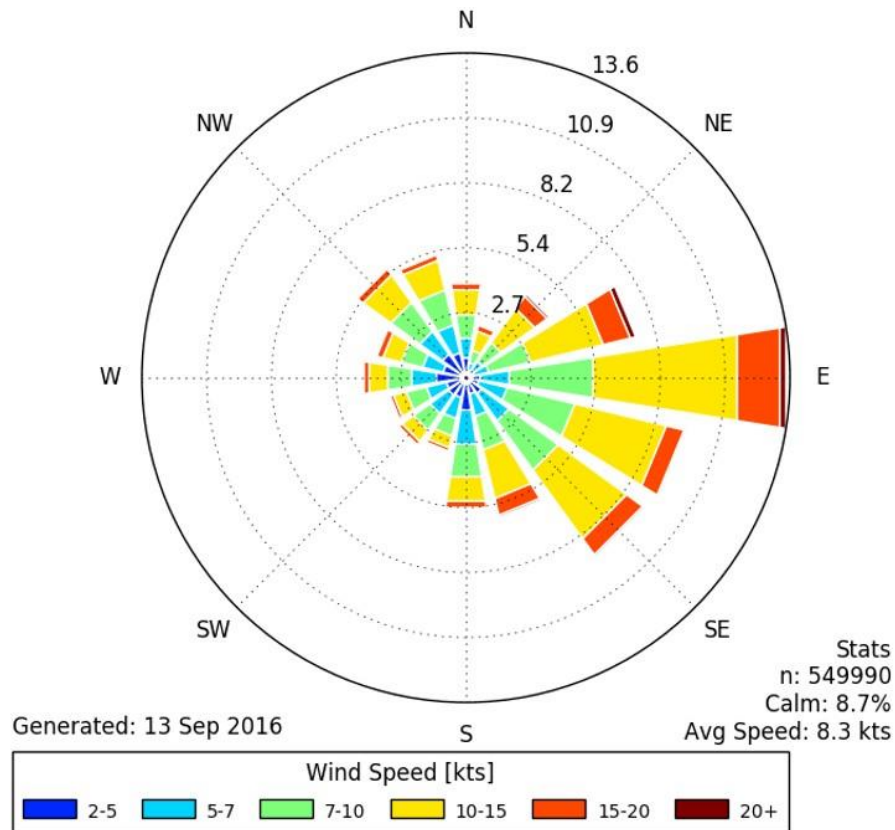


Figure 2-5 Wind Rose for Lake Worth Lagoon

2.4.3 Wave Climate

LWL experiences wind generated waves from north and south directions where fetches are 1 to 3 miles, and east and west directions where fetches are a few tenths of a mile to 0.5 miles for the width of the lagoon. Wind waves generated within the lagoon demonstrate typical conditions and design conditions based on an extreme tropical event condition with a return period of 50 years, or a 2 percent chance of occurring in any year, which corresponds to a Category 2 hurricane with wind speed of 96 knots. Typical conditions within LWL show wave heights

ranging from 0.3 ft to 1.1 ft, having wave periods ranging from 0.9 seconds to 2.1 seconds, as shown in **Table 4-4**.

The Automated Coastal Engineering System (ACES) was used to estimate wave heights and periods for typical (20 knots) and design (96 knots) conditions for LWL exposure directions and fetches. The program was run in shallow water mode with average water depths based on the 2002-2003 bathymetric survey by Morgan & Eklund, Inc. and the Federal Emergency Management Agency (FEMA) 50 year surge height for the design condition.

2.4.4 Water Levels

The astronomical tide dominates the water level fluctuations throughout the lagoon while canal discharge has a minor effect primarily in the central portion of the lagoon near the C-51 canal. Tides in LWL are semi-diurnal with two high tides and two low tides each day. At the Port of West Palm Beach near the Lake Worth Inlet, NOAA station 8722588, the mean tide range is 2.72 ft. Near the South Lake Worth (Boynton) Inlet at Ocean Ridge, NOAA station 8722718, the mean tide range is 2.47 ft. In the central portion of the lagoon, at the mouth of C-51, NOAA station 8722654, the mean tide range is 2.46 ft (**Figure 2-6**). Canal discharge from C-51, during high flow conditions, usually associated with releases due to high rainfall periods, typically increases the water level in the central portion of the lagoon near C-51 by a few tenths of a foot.

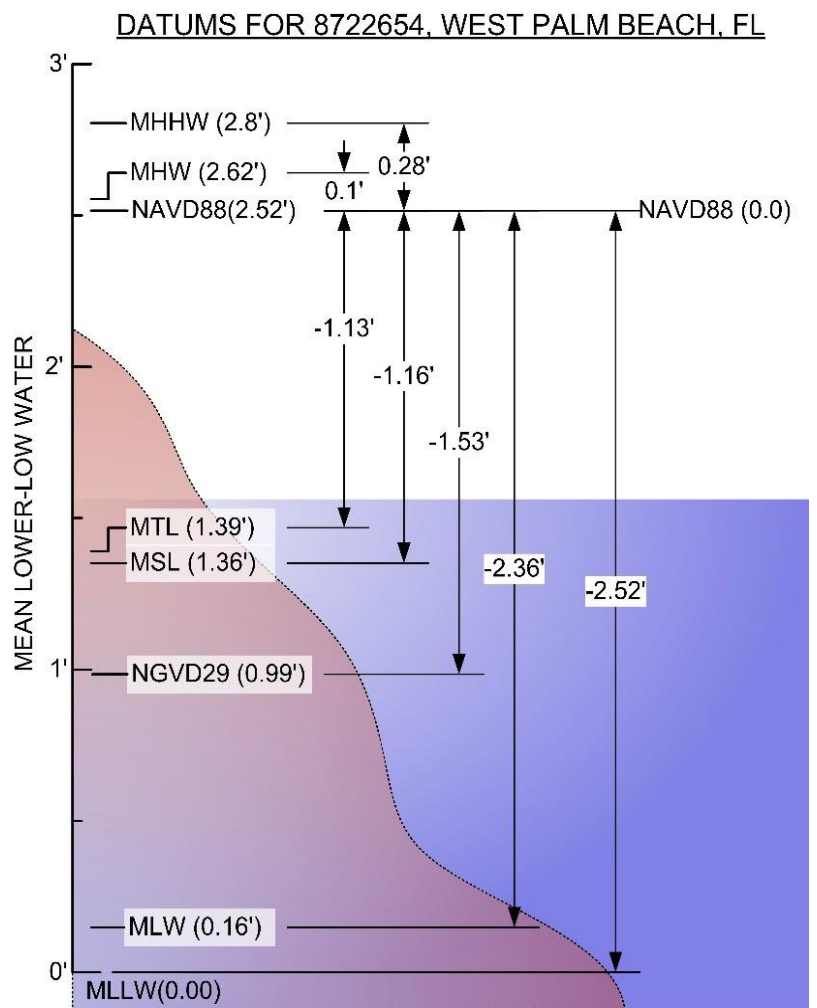


Figure 2-6 – Tidal Datums

2.4.4.1 Storm Surge

Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to physical forces. Surges occur primarily as a result of atmospheric pressure gradients and surface stresses created by wind blowing over a water surface. Strong onshore winds pile up water near the shoreline, resulting in elevated water levels along the coastal region and inland waterways. In addition, the lower atmospheric pressure, which accompanies storms, also contributes to a rise in water surface elevation. Extremely high wind velocities coupled with low barometric pressures (such as those experienced in tropical storms, hurricanes, and very strong northeasters) can produce very high, damaging water levels. In addition to wind speed, direction and duration, storm surge is also influenced by water depth, length of fetch (distance the wind blows over water), and frictional characteristics of the nearshore sea bottom.

The storm surge events can provide insight into the vulnerabilities of a given location through comparison with the existing topography. Water level (with storm surge) time series are critical for input into shoreline response and coastal storm risk modeling applications. A history of storms impacting LWL is displayed in **Figure 2-7**, showing the storm paths of 48 tropical storms and hurricanes which have passed within 50 km of the project area since 1851. The return period of hurricanes for this region is 3.4 years per storm event, as calculated by dividing the POR by the number of storms. **Table 2-7** provides peak storm surge heights by return period for Lake Worth Inlet, Florida. Storm surge levels versus frequency of occurrence presented in **Table 2-7** were obtained from data compiled by the University of Florida for the Florida Department of Transportation (Sheppard and Miller, 2003).

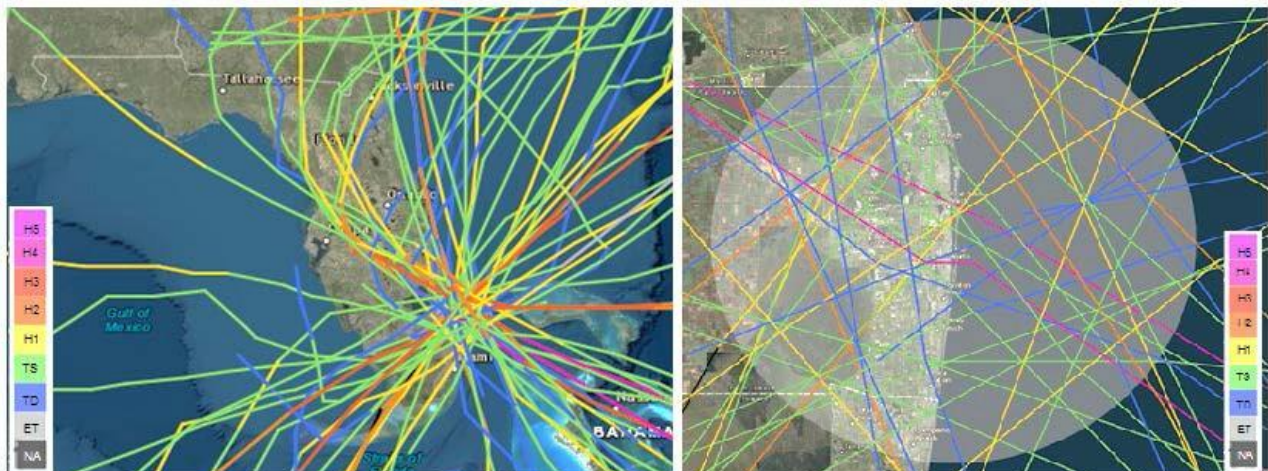


Figure 2-7 – LWL Storm History

Table 2.7 - Peak Storm Tide Elevations

Storm Return Period (Years)	Peak Storm Surge Height		
	ft-NGVD29	ft-NAVD88	ft-MSL
10	5.7	4.2	8.5
20	7.6	6.1	10.4
50	9.7	8.2	12.5
100	11.1	9.6	13.9
200	12.5	11.0	15.3
500	15.0	13.5	17.8

2.4.4.2 Sea Level Change

Relative sea level (RSL) refers to local elevation of the sea with respect to land, including the effects of lowering or rising land through geologic processes such as subsidence and glacial rebound. It is anticipated that the global mean sea level (MSL) will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea level change (SLC) on design, construction, operation, and maintenance of coastal projects, the USACE has provided guidance in the form of Engineering Regulation, ER 1100-2-8162 (USACE, 2013) and Engineering Technical Letter, ETL 1100-2-1 (USACE, 2014).

ER 1100-2-8162 provides both a methodology and a procedure for determining a range of SLC estimates based on global SLC rates, the local historic SLC rate, the construction (base) year of the project, and the period of Federal participation for the project. Three estimates are required by the guidance, a baseline (or “low” estimate, which is based on historic SLC and represents the minimum expected SLC, an intermediate estimate, and a high estimate representing the maximum expected SLC. More details are provided in the referenced ER and ETL.

The LWL project area is located approximately 60 miles from NOAA tide gauge #8723170 at Miami Beach, Florida. The historical local sea level rise rate taken from this gauge was determined to be 2.39 mm/year, with a 95% confidence interval of +/- 0.43 mm/yr based on monthly mean sea level data from 1931 to 1981, which is equivalent to a change of 0.78 feet in 100 years (USACE, 2015; NOAA, 2016). Given the project’s base year of 2019, a table of SLC rates is included for each of the three required scenarios through 100 years from the project base year (**Table 2-8**). **Figure 2-8** provides a graphic representation of the three levels of projected

future SLC for the 50-year planning horizon of the project (2019 to 2069) as well as an additional 50 years (to 2119). By 2069 RSL rise predictions equal 0.39 ft, 0.85 ft, and 2.32 ft for the baseline, intermediate, and high SLC curves, respectively.

The local rate of vertical land movement is found by subtracting the regional MSL trend from local MSL trend. The regional MSL trend is assumed equal to the eustatic MSL trend of 1.7 mm/year (USACE, 2015). Therefore, at the LWL project, there is 0.69 mm/year of local vertical land movement.

Table 2.8 - Relative sea level rise for Lake Worth Lagoon

Year		Baseline (Historic)		Intermediate (NRC Curve I)		High (NRC Curve III)	
		m	ft	m	ft	m	ft
Base Year	2019	0.0000	0	0.0000	0	0.0000	0
	2020	0.0030	0.01	0.0030	0.01	0.0091	0.03
	2025	0.0152	0.05	0.0244	0.08	0.0549	0.18
	2030	0.0274	0.09	0.0457	0.15	0.1067	0.35
	2035	0.0396	0.13	0.0671	0.22	0.1646	0.54
25 Year	2040	0.0518	0.17	0.0915	0.3	0.2287	0.75
	2045	0.0640	0.21	0.1189	0.39	0.2988	0.98
	2050	0.0762	0.25	0.1433	0.47	0.3720	1.22
	2055	0.0854	0.28	0.1738	0.57	0.4543	1.49
	2060	0.0976	0.32	0.2012	0.66	0.5396	1.77
	2065	0.1098	0.36	0.2348	0.77	0.6311	2.07
50 Year	2069	0.1098	0.39	0.2348	0.85	0.6311	2.32
	2070	0.1220	0.4	0.2652	0.87	0.7287	2.39
	2075	0.1341	0.44	0.2988	0.98	0.8323	2.73
	2080	0.1463	0.48	0.3354	1.1	0.9390	3.08
	2085	0.1585	0.52	0.3720	1.22	1.0549	3.46
75 Year	2090	0.1707	0.56	0.4085	1.34	1.1738	3.85

Year		Baseline (Historic)		Intermediate (NRC Curve I)		High (NRC Curve III)	
		m	ft	m	ft	m	ft
	2095	0.1829	0.6	0.4482	1.47	1.2988	4.26
	2100	0.1951	0.64	0.4878	1.6	1.4299	4.69
	2105	0.2073	0.68	0.5305	1.74	1.5671	5.14
	2110	0.2195	0.72	0.5732	1.88	1.7104	5.61
	2115	0.2287	0.75	0.6189	2.03	1.8567	6.09
100 Year	2119	0.2409	0.79	0.6555	2.15	1.9817	6.5

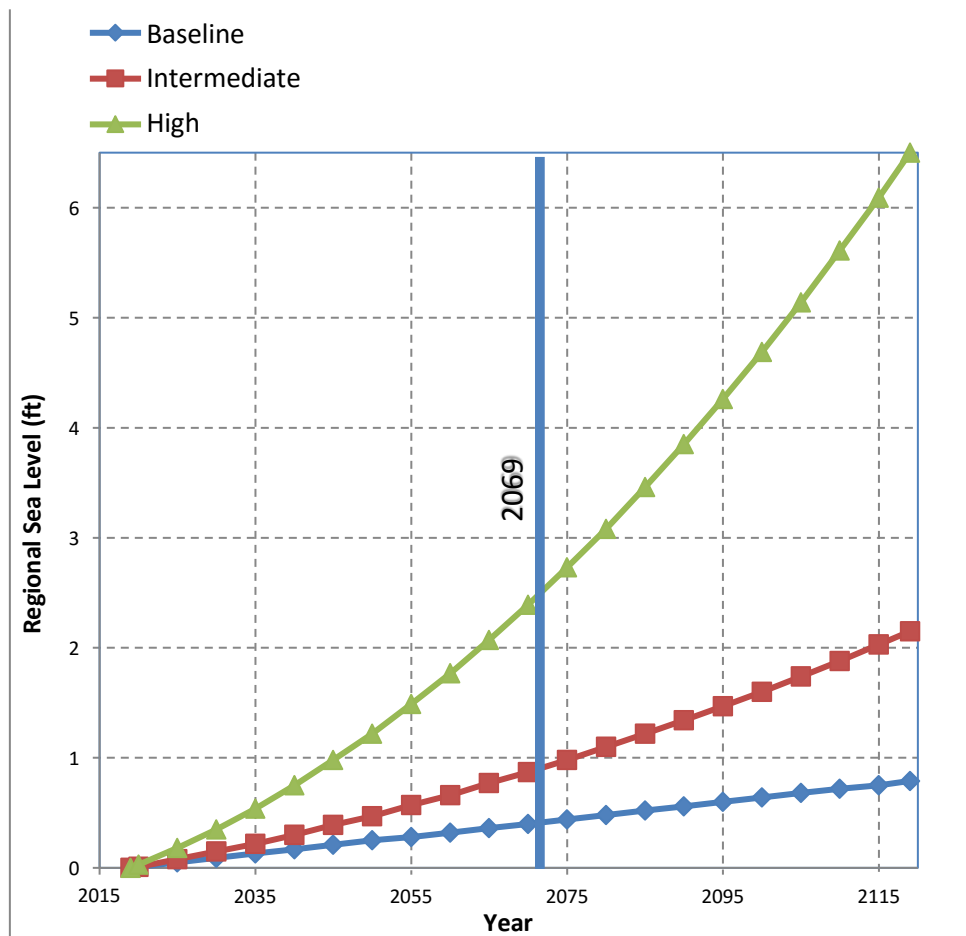


Figure 2-8 – Relative sea level change

3.1 UNDERSTANDING THE PROBLEM: SYNTHESIZING THE DATA

The sponsor, PBC DERM, provided the Corps with a plethora of data collected within and outside LWL. Many components are interdependent and inseparable. Therefore, the sources of the problem must be understood and then analyzed before a solution can be determined. In essence, the Corps was presented with one problem with two potential sources: a degraded environment within LWL, which was caused by muck (sediment) accumulation and salinity changes brought about by Corps projects.

3.2 Salinity

The salinity regime in LWL is strongly influenced by episodic freshwater flows from the C-17, C-51, and C-16 canals, and ranges from freshwater to hypersaline. Other controlling factors and processes include saltwater inflows from the ocean through the Lake Worth and South Lake Worth tidal inlets. Freshwater inflows combined with marine processes operating at tidal, meteorological, and seasonal time scales determine the overall salinity regime within LWL. All of these variables were analyzed to show salinity regime within the lagoon.

3.2.1 Tidal Prism

The salinity regime in LWL is strongly influenced by episodic freshwater flows from the C-17, C-51, and C-16 canals through their respective control structures. Other controlling factors and processes include saltwater intrusion from the Lake Worth tidal inlets, precipitation, and evaporation. Freshwater inflows combined with marine processes operating at tidal, meteorological, and seasonal time scales determine the salinity regime of the LWL.

Determining the tidal prism is a simple way to approximate the flushing of a lagoon or estuary. This estimates the overturning or flushing rate as the estuary volume divided by the freshwater volume plus estuary tidal prism (**Eq. 1**).

$$\tau = \frac{\text{LagoonVolume}(ft^3)}{Q_{FW} + Q_{SW} \left(\frac{ft^3}{TideCycle} \right)} \quad \text{Eq. 1}$$

As noted earlier, the Lagoon is connected to the Atlantic Ocean by two inlets, Lake Worth Inlet and South Lake Worth (Boynton) Inlet. The dimensions for each inlet are provided in **Table 3-1**.

Table 3.1 – Lake Worth Lagoon Inlet Dimensions

Inlet	Width	Depth
Lake Worth Inlet	800 feet	35 ft
South Lake Worth Inlet	130 feet	6-12 feet

Table 3-2 shows the tidal prism estimates for the Lake Worth Inlet and the South Lake Worth (Boynton) Inlet. The Lake Worth inlet tidal prism is based on an empirical relationship between tidal prism and cross sectional area of the inlet (Jarrett 1976). The South Lake Worth (Boynton) Inlet tidal prism is based on a 13 month average of flow calculations from an acoustic Doppler current profiler (ADCP) monitoring effort (Stamates 2013). The lagoon volume is based on the 2002- 2003 bathymetry survey conducted by Morgan and Eklund. The canal flow volume is typical of the total flow represented by measurements from June 6, 2007. The overturning rate given by this approximation is 2.3 tidal cycles. This is a rough approximation, which assumes LWL is fully mixed and there is a complete exchange of water during each tidal cycle. The actual overturning rate is likely higher, needing more tidal cycles for flushing, but this estimate gives some indication of the influence of the tidal flow within LWL.

Table 3.2 - Lake Worth Tidal Prism Flushing Rate

	Water Volume (ft³)	Incoming Volume Flow Rate (ft³/tidal cycle)	Number of Tidal Cycles
Lake Worth Inlet ⁽¹⁾	n/a	9.32E+08	n/a
South Lake Worth (Boynton) Inlet ⁽²⁾	n/a	1.22E+08	n/a
Canal Flow Volume (June 6, 2007)	n/a	2.65E+07	n/a
Lagoon Volume (2002-2003 Bath Survey)	2.47E+09	n/a	n/a
Totals	2.50E+09	1.08E+09	2.3

3.2.2 Currents

Currents in the LWL are influenced primarily by tides moving through two inlets, Lake Worth Inlet and South Lake Worth (Boynton) Inlet which connect the lagoon to the Atlantic Ocean. During the flood tide at Station 4 the average current is about 0.3 knots. Observed current

measurements are available from two current meters located near Currie Park (Station 4) and Bryant Park (Station 3), which collected velocity data between July and October 2001 as part of the salinity and flow management study performed for the SFWMD (Zarillo 2002).

The flood tide produces an average current of about 0.75 knots at Station 4. During ebb tide at Station 4, the average current is about 0.5 knots. The flood tide produces a maximum current of about 1.25 knots at Station 4. During the flood tide at Station 3 the average current is about 0.25 knots. The flood tide produces a maximum current of about 0.7 knots at Station 3. During the ebb tide at Station 3 the average current is about 0.4 knots. The flood tide produces a maximum current of about 1.0 knot at Station 3.

3.2.3 Freshwater Flows

June 1987 – August 2016 was used as the period of record (POR) for this analysis as the most recent major update to the hydraulics of the LWL system was the construction completion of S-155 in 1987. The seasonality of the LWL watershed is defined by a wet season (May to October) and dry season (November to April) with the water year defined as May to April. Daily average flow was acquired through SFWMD's DBHYDRO online database for the entire POR. For the POR, the majority of the freshwater flows into LWL came from S-155, composing 65% of the total volume. The S-41 structure conveyed 25% of the total volume, and S-44 carried 10% of the total volume (**Figure 3-1**). The wet and dry season allocation differences were minimal as compared to the total allocation results showing that S-155 and the C-51 canal are providing the most freshwater inflows into LWL (**Figure 3-2** and **Figure 3-3**). Data used in the charts is provided in **Table 3-3**.

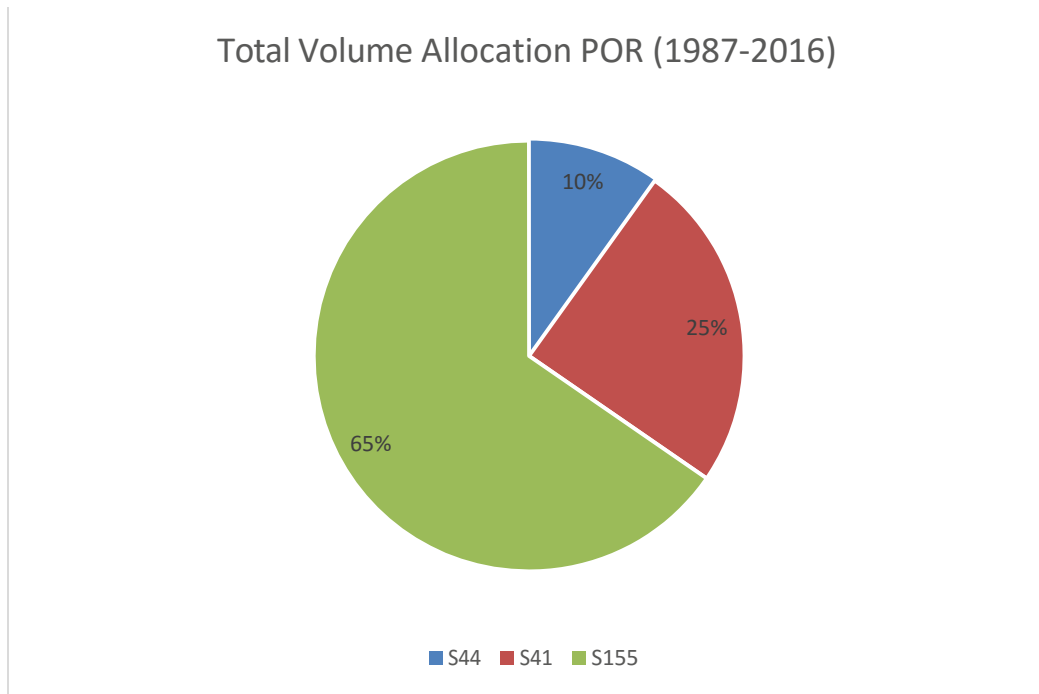


Figure 3-1 - LWL Total Fresh Water Inflow

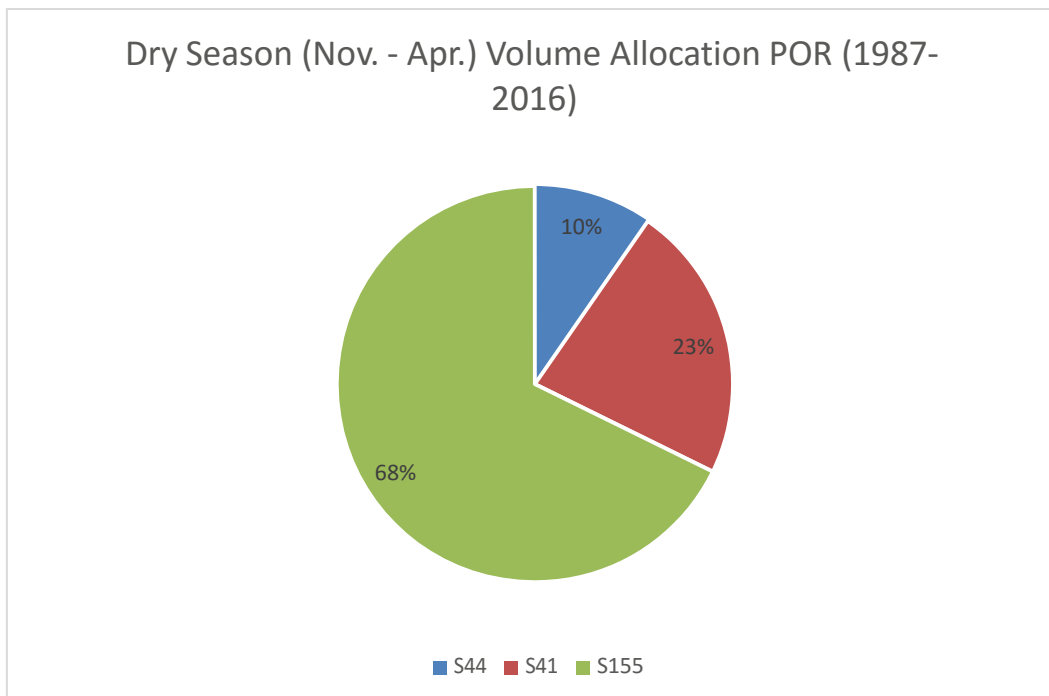


Figure 3-2 LWL Dry Season Fresh Water Inflow

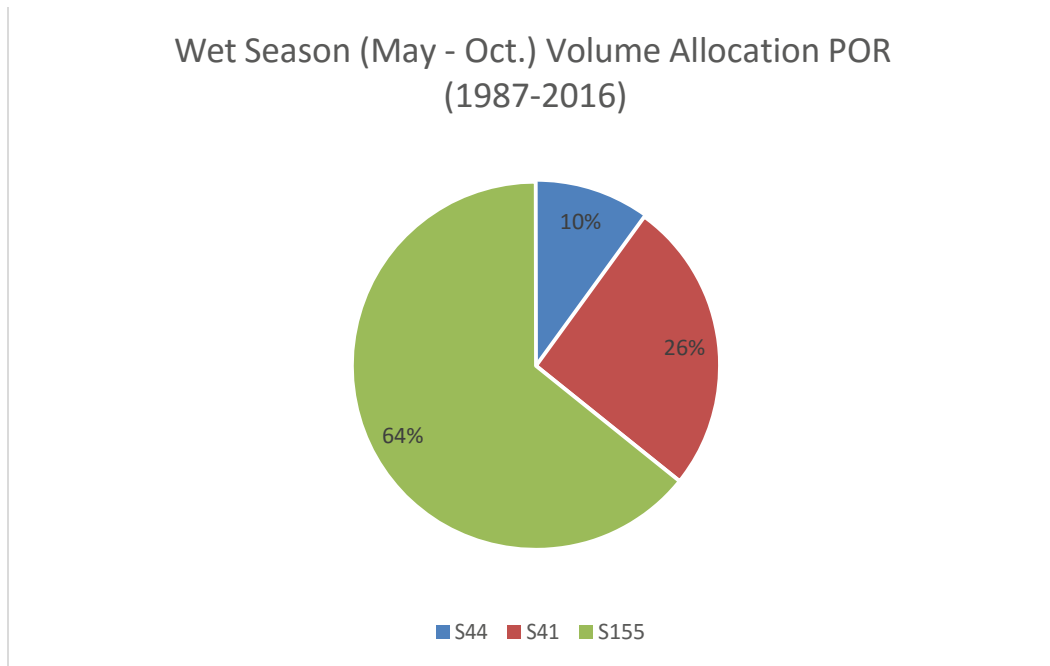


Figure 3-3 LWL Wet Season Fresh Water Inflow

Table 3.3 - Freshwater Flow Allocation from Structures S-44, S-41, and S-155 into LWL

Structure	Total		Dry Season (Nov-Apr)		Wet Season (May-Oct)	
	Vol. (ac ft)	%	Vol. Dry (ac ft)	%	Vol. Wet (ac ft)	%
S-44	1,334,114	10%	431,571	10%	902,543	10%
S-41	3,335,160	25%	1,009,983	23%	2,325,177	26%
S-155	8,820,452	65%	3,025,071	68%	5,795,380	64%
Total	13,489,725	100%	4,466,625	100%	9,023,100	100%

The annual flows from S-155, S-44, and S-41 were aggregated for each wet and dry season (**Figure 3-4**). The wettest years (water years) were 1995, 1996, and 1998 with volumes totaling 828,358 ac-ft, 814,227 ac-ft, and 805,168 ac-ft, respectively. By contrast the driest years were 1990, 2012, and 2007 with volumes totaling 75,912 ac-ft, 132,705 ac-ft, and 224,771 ac-ft, respectively.

The majority of the flows into LWL are from C-51 and released through the S-155 spillway structure. The average flows through S-155 for the POR are 431 cfs with a minimum of 0 and maximum of 7,142 cfs, which occurred on Oct. 16, 1999 due to Hurricane Irene.

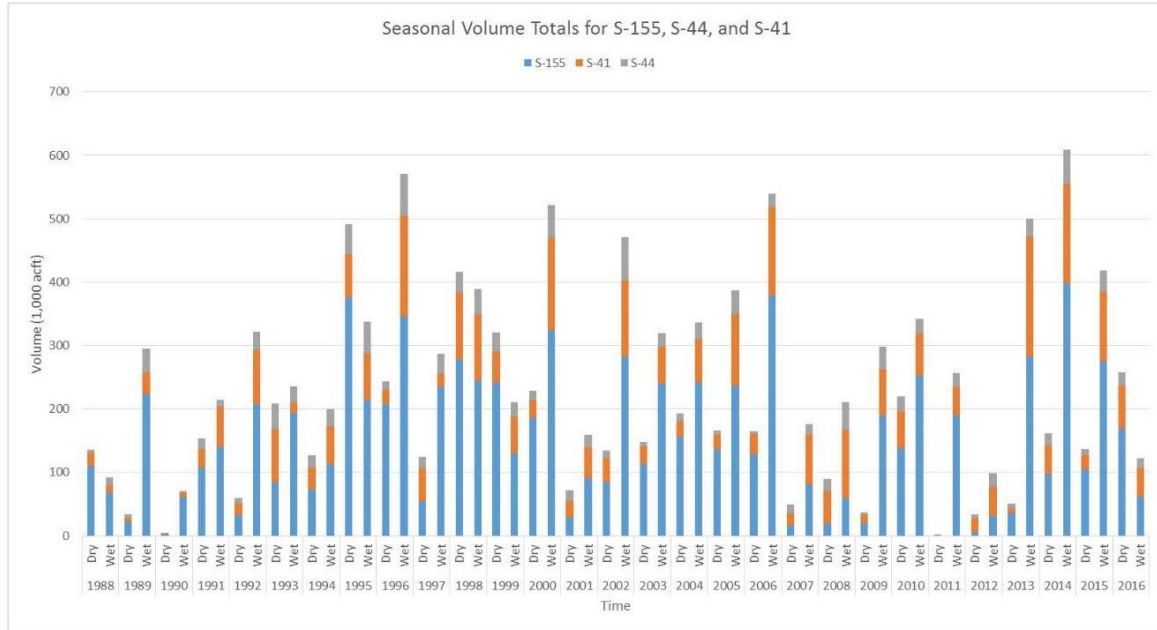


Figure 3-4 - Freshwater Flows by year

Based on the discharge data from the S-44, S-41, and S-155 spillway structures, it can be concluded that the C-51 canal and its associated basins are responsible for the majority of the freshwater flows into the LWL. The LWL will likely experience decreased salinity based on proximity and magnitude of freshwater discharges through S-155.

3.2.4 Freshwater Effects

An understanding of the tidal flow and freshwater flow effects on salinity in the lagoon are presented in the series of reports prepared for the SFWMD on hydrodynamic modeling for LWL (Zarillo 2002). The report indicates that LWL can be divided into three zones, characterized by different salinity regimes (North, Central, and South). The Northern zone (relatively high salinity in the LWL) is predicted to occur from the vicinity of Palm Beach Inlet and northward. Also within the northern zone, low salinity events occur with the same frequency as in the central zone, but salinity values are predicted to remain above 20 psu and generally occur in the range of 20 to 25 psu. A central zone between Palm Beach Inlet and South Lake Worth Inlet is characterized by frequent low salinity events occurring at the meteorological time scale of a few days to two weeks. Salinity levels during these events dropped to values of 5 to 15 psu and generally rebound to levels at or below 25 psu. A third southern zone of the Lagoon is predicted to be subject to low salinity levels

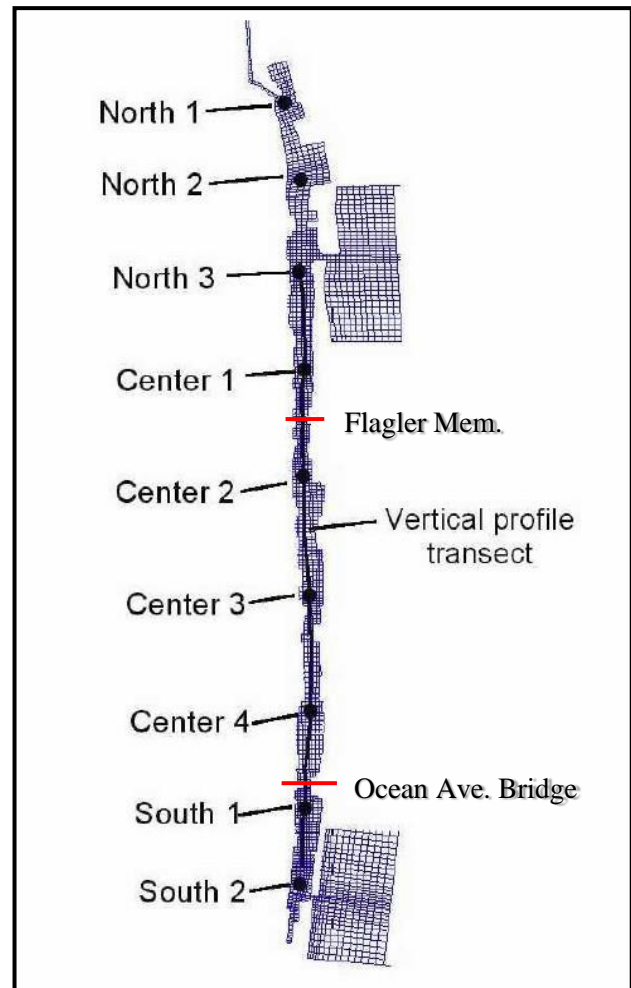


Figure 3-5 Numerical salinity recording stations used to analyze results of EFDC model test cases.

similar to those of the central zone. However, salinity levels generally rebound to levels between 25 and 30 psu compared to levels in the central zone where rebound is between 15 and 25 psu.

Figure 3-5 shows the three zones represented by the model output station. Tidal prism flushing and salinity in LWL can also be modified by wind. **Figure 3-6** shows the effect of a wind from the north on the tidal prism at the South Lake Worth (Boynton) Inlet. The wind from the north pushes water in LWL to the south, which increases the ebb tide volume and suppresses the flood tide volume. Alternately, wind from the south pushes water to the north away from the Boynton Inlet, reducing the ebb tide volume and increasing the flood tide volume. The opposite is generally true for Lake Worth Inlet at the north end of the lagoon.

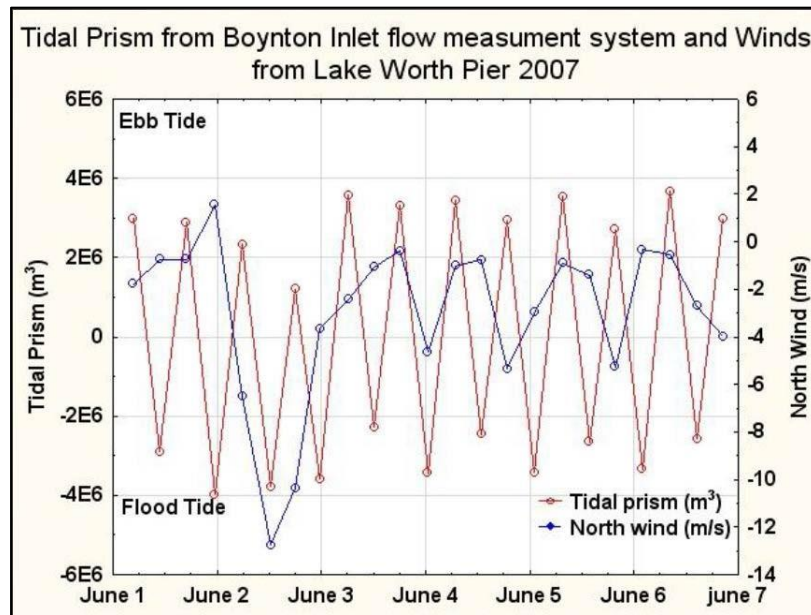


Figure 3-6 A time series of the tidal prism estimate and the average of the north component of the wind velocity for the period of those tides. (Stamates 2013)

3.2.5 Johns Island Salinity Study

Salinity was also monitored at John’s Island by PBC DERM staff beginning in April 2010 to study salinity changes due to stormwater releases from C-51 in the central LWL. The primary monitoring site southeast of John’s Island was selected due to its proximity to SFWMD’s S-155 spillway and adjacent to PBC estuarine restoration projects (discussed in Chapter 4). PBC DERM staff deployed and maintained one multi-parameter in-situ sonde at this location continuously from April 2010 to present.

Overall there are several trends in the data that clearly show the close relationship between discharge events at the S-155 structure and salinity levels in the central LWL (**Figure 3-7**). As expected, the wet season typically brings increased rainfall totals and eventually leads to associated stormwater releases from the S-155. Immediately following each release a corresponding decrease in salinity has been observed and sustained until S-155 flow slows/stops. Local rainfall without associated S-155 discharge events appears to have little significant impact on salinity levels. This is apparent as during the 2011 dry season there were multiple rainfall events that occurred without associated S-155 discharge, while salinity remained high during the same period.

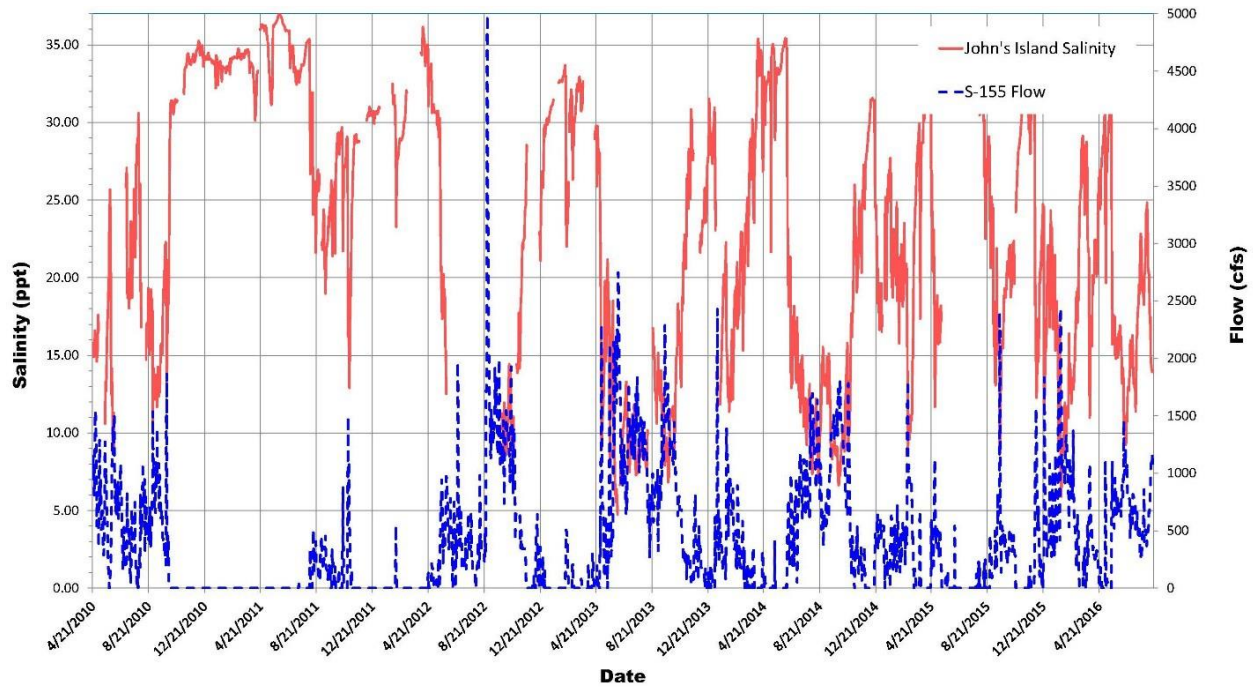


Figure 3-7 Johns Island Salinity Measurements

3.3 Overall Sediment Composition within Lake Worth Lagoon

Stormwater discharge is a major source of sediment input to the LWL that negatively impacts water quality and estuarine habitats (Refer to EN Attachment B for Land Use discussion). PBC conducted a study in 2008 to assess the sediments entering central LWL through the C-51 canal. C-51 contributes approximately half of the freshwater inflow to the LWL, and brings sediments from the agricultural areas of the sandy flatlands and Lake Okeechobee. Once various organic matter and fine sediment rests upon the lagoon bed, the material flocculates into a clayey/sticky foul smelling material aptly named “muck” (**Figure 3-8**). In shallow-water areas, portions of the muck is re-suspended during low-frequency wind/ wave events which then settles into other deeper areas within the lagoon (i.e., dredge holes). Once the muck settles within the dredge holes, the muck layer will continue to accumulate. DERM, in cooperation with SFWMD, conducted a study in 2011 which indicated that between 1.2 and 1.9 million cubic yards of muck deposits exist within 2.5 miles of the C-51 (PBC 2013).

Results from a 2008 sediment sourcing study showed that organic matter makes up 19% of the sediment composition in the LWL and 65% of this organic matter is derived from terrestrial (on land) sources. Sod probably contributes <10% of the inorganic fraction of the muck sediment

but it likely contributes 30-50% of the sediment found in tributary canals in the C-51 east basin. Sediment inputs from the C-51 east basin and the M1 and Wellington Canals in the C-51 west basin collectively contribute <30% of the inorganic matter. A large fraction of the inorganic component (>70%) is likely to be derived from source areas west of Loxahatchee in the western reaches of the C-51 basin and farther west.



Figure 3-8 – LWL Muck grab sample

Organic matter made up an average of 19% of the dry sediment mass in LWL and gave the muck sediments their characteristic black color and high oxygen demand. Sources of this organic matter were determined using stable carbon isotopes. The results show that an average of 65% of the organic matter in LWL sediments was derived from terrestrial sources (i.e., land derived) and 35% was produced through primary production in LWL. Calculations using the various metal/metal ratios support the following statements:

- (1) Sod probably contributes <10% of the inorganic fraction of the muck sediment in LWL;
 - (2) Sod probably contributes 30 to 50% of the sediment found in tributary canals in the C-51 east basin such as the E1 to E4 series of canals;
 - (3) Sediment inputs to LWL from the C-51 east basin (the E1 to E4 canals mentioned above) seem to account for <30% of the inorganic matter found in LWL sediments;
- and,

- (4) A large fraction of the inorganic component of the sediment in LWL seems to be derived from areas west of Loxahatchee in the western reaches of the C-51 west basin and farther west.

The LWL sediment thickness study was performed in 2009 to investigate, map and quantify the horizontal and vertical extent of the reported sediment/muck deposits within areas centered about the C-51 discharge canal. The study area ranged from the northern most site at 12 Oaks to the southern extremity at Bryant Park, and included the dredge holes/ areas of Currie Park, South Cove, Palm Beach Atlantic University, Everglades, Ibis Isles, Snook Islands, and Blossom's Hole.

The results of the muck/sediment thickness study indicate much of the original bottom in the study area is overburden with a thick semi-fluid muck layer. Analysis of the data shows a strong correlation between the relative depths of water and the thickness of the muck layer, as well as the type of material present. In general, holes or deeper areas contained thicker layers of muck sediment.

Additionally, within each site the thicker layers of muck corresponded to a higher percentage of fines within the sediment analyzed. Overall, sites closest to the C-51 discharge had the highest percentage of fines and thickest muck. Average percentage of fines for Ibis Isle North, Ibis Isle South, and Snook Islands, and within those areas the highest percentage of fines, was generally found in the thickest muck.

3.3.1 C-51 Sediment Trap

To address the incoming sediment from C-51, in January of 2006, a collaboration between the SFWMD, PBC DERM, and the City of West Palm Beach, initiated construction and monitoring of a sediment trap upstream of the S-155 spillway in the C-51 canal, just west of I-95 highway. Construction was completed in July 2008 (**Figure 3-9**).

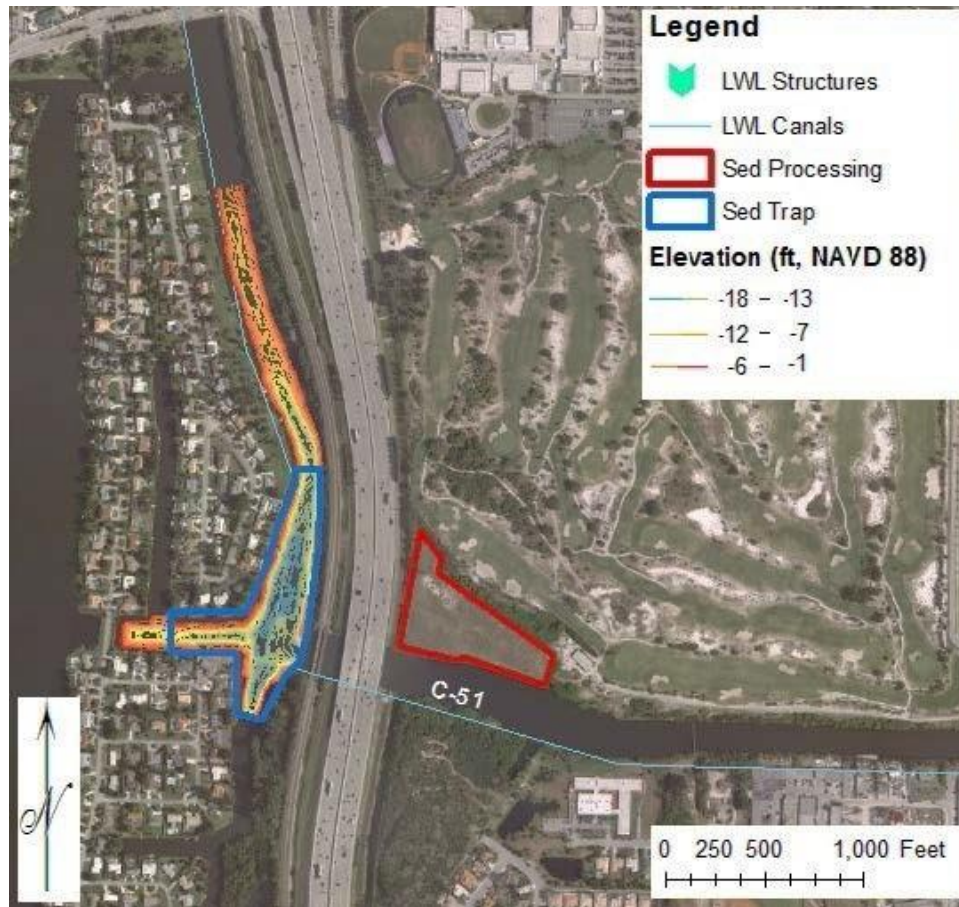


Figure 3-9 Sediment Trap Location

The sediment trap is approximately one mile in length of C-51 canal and was initially dredged in 2007. Over 100,000 cubic yards of muck were hydraulically dredged from the C-51 canal and transported through pipes to settling ponds. The muck was then dewatered, treated, and hauled away for beneficial uses. The sediment trap has not been dredged for muck since the initial construction and dredging. The SFWMD is responsible for operating and maintaining the sediment trap, which has been surveyed every year since construction completion (**Table 3-4**).

The sediment trap surveys and analysis shown in **Table 3-4** show the accumulation and scouring of the trap area. Early surveys show the accumulation of inbound sediment was trapped and reduce the amount of muck entering LWL. Due to expense of removing and treating of muck, the sediment trap has not been dredged since original construction. The sediment trap surveys also indicate that when the muck is allowed to attenuate through lack of maintenance, it can be re-suspended and pushed in the direction of flow once a cavity has been filled. Qualitatively, this muck dispersement could be theoretically happening within the LWL with each incoming tide

or low frequency event. PBC has commented on several occasions that muck waves move in and around the lagoon covering over existing dredge holes and eventually covering over existing habitat.

Table 3.4 - Sediment Trap Annual Volume Survey Results

Year	Accretion (Cu. Yds.)	Erosion (Cu. Yds.)	Net (Cu. Yds.)
Nov 2007 – Oct 2008	8,325.01	2,500.06	5,824.95
Oct 2008 – Aug 2009	8,403.27	195.21	8,208.06
Aug 2009 – Sept 2010	2,144.20	2,384.72	-240.52
Sept 2010 – June 2013	11,471.85	1,707.86	9,763.99
June 2013 – Jan 2014	2,573.22	3,247.06	-673.84
Jan 2014 – June 2014	789.16	9,734.09	-8,944.93
June 2014 – Jan 2015	3,083.79	2,048.87	1,034.92
Nov 2007 – Jan 2015	18,979.98	4,007.35	14,972.64

3.4 Final Problem Statement

LWL has encountered losses in seagrass, mangrove, and oyster habitat due to dredging and filling operations and large-scale freshwater discharges into LWL. The Corps’ dredging and filling activities have been previously constructed a section 1135 project (i.e. Peanut Island). The flood water discharges occur from Canals 16, 17, and 51 (C-16, C-17, and C-51, respectively). Since C-16 and C-17 are both in close proximity to the inlets to the ocean, C-51 is the main contributor to reduced salinity and increased sediment load within the central portion of LWL. C-51 is a component of the Central and Southern Florida (C&SF) project and provides both flood risk management and water supply to the LWL watershed. Freshwater releases from C-51 are controlled by an automated gated spillway structure (S-155) into the LWL based on the stages in the canal. However, operational changes to freshwater pulses from C-51 to alleviate the salinity drop and sedimentation loads are not possible within the scope of CAP.

Due to tides and other climatic factors, low salinity values are short lived outside the influence of C-51 freshwater flows where salinity fluctuations are more prevalent. Farther away from C-51 lagoon areas have more tidal exchange and less fluctuations. Therefore, the suspended organic sediments for which freshwater pulses are laden with are impacting the lagoon’s capability to sustain a viable benthic community. After each freshwater pulse, more sediment is accumulating and eventually trapped within the lagoon. Over time, the accumulated sediment within LWL covers existing benthic habitats and potentially threatens other habitable areas.

4.1 **FIXING THE PROBLEM – DETERMINING THE SOLUTION**

SAJ reviewed and analyzed all the information provided by the sponsor to understand the LWL system and narrow down the problem to a set of alternative solutions. CAP 1135 cannot solve the larger scale problems such as the salinity or sedimentation problems summarized in the preceding chapter. CAP is required to demonstrate that a project can provide environmental benefits within reasonable limitations of the project and project life cycle, as well as an agreed methodology and costs by sponsor and Federal government. This heading provides leading information to how the Project Delivery Team (PDT) determined a recommended solution by discussing the:

- Benefits of small ecosystem projects;
- Possible alternatives for CAP 1135 project;
- Ideal location for the habitat restoration;
- Sediment source for habitat creation; and
- Rough order of magnitude (ROM) for a selected set of alternatives.

4.2 **Benefits of Ecosystem Creation**

Florida's coastal lagoons and estuaries are extremely important ecosystems, as they support unique and important fish and wildlife populations. The following sections provide a summary of information acquired since 2008 on seagrass, mangroves, and oyster reefs within LWL. These components are critical elements in the alternative selection process for CAP 1135 and provide a window to current health of the system.

4.1.1 **Seagrass Habitat**

Seagrasses act as ecological engineers in coastal waters (Wright and Jones 2006), providing valuable ecological services to the marine environment (Orth et al. 2006, Costanza et al. 1997). These services include provision of physical habitat structure/shelter, alteration of water flow, nutrient cycling, organic carbon production and export, sediment stabilization, enhancement of biodiversity, trophic transfers to adjacent habitats, and food web structure (Hemming and Duarte 2000; Orth et al., 2006).

Halophila species, which are the dominant species in the Lagoon, are particularly sensitive to anthropogenic influences and experience rapid turnover from season to season, and rapidly recruit naturally. The earliest evaluation of seagrass in the LWL was compiled from a 1940 aerial survey and documented 4,271 acres of seagrass (PBCERM and FDEP 1998). In 1975, a

resource inventory found that only 161 acres of seagrass remained in LWL. While there is uncertainty about the accuracy of methods used, the results indicate a substantial loss of seagrass. The loss was thought to be a result of extensive dredging and filling, sewage disposal outfalls that directly discharged to LWL, degraded water quality, and changes in salinity (PBCERM 1998). Historical change of the seagrass coverage within LWL is shown in **Table 4-1**.

Table 4.1 – Historic Extent of Seagrass in LWL

Year	Acres	Increase/ Decrease	Surveyor/ Source	Method	Percent of Lagoon
1940	4,271	n/a	PBC DERM 1990	aerial photography	55%
1975	161	Decrease	Braun 2006	resource inventory	2%
1990	2,110	Increase	Dames & Moore and PBC DERM	in-water surveys	27.2%
2001	1,646	Decrease	PBC DERM	aerial photography	21.2%
2007	1,688	Increase	PBC DERM	aerial photography	21.7%

In 2007, analysis of aerial photography showed that seagrass beds covered at least 1,688 acres, or 21.74%, of the Lagoon. Approximately 65%, or 1,090 acres, of seagrasses were identified in the northern segment (Little Lake Worth just north of PGA Blvd to Flagler Memorial Bridge); 12%, or 205 acres, were identified within the central segment (Flagler Memorial Bridge to Lake Ave. Bridge); 23%, or 393 acres, were mapped within the southern segment (Lake Ave Bridge to Ocean Ave Bridge in Boynton Beach). Since 2009, approximately 15 acres of additional seagrass habitat in the central LWL has been created as a result of PBC restoration projects.

4.1.2 Mangrove Habitat

Mangroves serve very important functions in the ecology of the LWL. They recycle nutrients and promote the nutrient mass balance of estuarine ecosystems. Mangrove leaves, wood, roots, and detrital material provide essential food chain resources, and provide habitat for many wildlife endangered and threatened species and species of special concern. They also serve as storm buffers, stabilizing shorelines and fine substrates with their roots, thereby reducing potential turbidity and enhancing water clarity.

The coverage of mangrove habitat in the Lagoon continues to increase as a result of restoration efforts. In 2007, aerial photography of the LWL was acquired to map the extent of essential fish habitats, including mangroves, and determine large-scale historical trends. After acquiring the aerial photographs, individual habitat boundaries were defined according to signatures apparent on the photography. Ground truthing methodologies were then applied to verify photographic signatures with actual field conditions. Including restoration projects completed since the 2007 survey, the Lagoon is estimated to contain approximately 295 acres of mangroves, which represents an 8% increase since 1985.

Between 1985 and 2007, increases in mangrove habitat were observed within the north (33.1 acres) and central (5.8 acres) portions of the lagoon, which can be partly attributed to PBC restoration projects, including Munyon Island, Peanut Island, John's Island, and Snook Islands (EN Attachment C). The removal of exotics and the protection and natural recruitment of mangroves along the shoreline of John D. MacArthur Beach State Park are also believed to increase the mangrove habitat in the north segment of the LWL. A decrease of mangrove habitat was observed in the South LWL (-3.6 acres). Between 2008 and 2012, increases in mangrove habitat were observed primarily in the north (0.9 acre) and central (11.3 acres) Lagoon and are a direct result of restoration efforts.

4.1.3 Oyster Habitat

Oysters provide numerous ecological benefits including habitat diversity, erosion control and improvement of water quality. The LWL is a productive system with patches of healthy oyster beds that provide the recruitment necessary to seed large (e.g., Snook Islands) and small restoration projects (e.g., Peanut Island), as long as other environmental factors (salinity, hydrology, food availability) and substrate type (hard bottom, mud) are considered.

Based on a two year monitoring study by Scarpa et al., 2008 additional restoration projects should not only be successful, but would improve water quality, provide erosion control and increase habitat for associated species, such as other invertebrates, fish and birds. Since 2009, restoration projects sponsored by PBC have resulted in the addition of nearly 13 acres of oyster reefs in the south and central LWL. Additional details are in **Table 4-2** below.

Table 4.2 – Oyster reef creation projects within LWL

Project Name	Location	Year Completed	Acres Created
Boynton Beach/Ocean Ridge Mangrove Riprap Project	South LWL	2009	0.26
Lantana Preserve and Bicentennial Park Volunteer Oyster Projects	South LWL	2009	0.04
Ibis Isle Restoration	Central LWL	2010	0.80
South Cove Natural Area	Central LWL	2012	1.00
Johns Island	Central LWL	2012	10.00
Bryant Park Wetlands	Central LWL	2012	0.06
Snook Islands Natural Area	Central LWL	2013	0.45
Total			12.61

4.2 Alternatives

Even though the lagoon is impacted by salinity, muck, and nutrients, PBC DERM has built various ecosystem projects within LWL, which have improved the immediate areas to sustainable and viable benthic habitats. EN Attachment C lists all the ecosystem projects conducted within the lagoon by PBC DERM. Scarpa and Laramore (2010) measured and compared the growth, abundance, reproductive effort, and health of the Eastern Oyster (*Crassostrea virginica*) at three of DERM’s projects: MacArthur, Ibis Isle, and Snook Island. Scarpa et al, quantitatively concluded that LWL is a productive system with patches of healthy oyster populations that can be expanded by providing substrate and relying on natural recruitment. Island creation or sand capping projects raised the selected areas within the lagoon to inter-tidal elevations to avoid the reoccurring problem of the infilling of aquatic vegetation and established marine life due to submerged muck waves.

4.2.1 Island Creation

The Snook Islands restoration project was a 1.2-mile ecosystem restoration project completed by PBC DERM during the summer of 2005. The purpose of the project was to increase the acreage of the existing mangrove fringe by filling in a deep anoxic dredge hole (**Figure 4-1**) just offshore with coarser sediment and replacing the failing shoreline armoring with inter-tidal and submerged habitats. This dredge hole was created when the golf course to the west of the Snook Islands was created.

A total of 1.2 million cubic yards of fill was transported from Peanut Island, placed, and graded to create four distinctive inter-tidal habitats. To protect the newly created upland areas from

incoming boat wakes and low-frequency wave events, approximately 28,000 tons of 1 to 3 feet diameter limestone riprap was used. This riprap enabled the successful incorporation of approximately 30,000 red mangroves (*Rhizophora mangle*) plants. These islands also prevented incoming waves from eroding the shoreline and provided habitat for oysters to attach and proliferate. Lastly, portions of the leeward side of the islands were left bare sandy areas; the upland area are preferred habitat for listed shorebirds, and the submerged areas can naturally recruit seagrass.

4.2.2 Sand Capping

The Grassy Flats Project site, located in the Town of Palm Beach, was completed by PBC DERM in 2015. The project site was selected for restoration due to its close proximity to the C-51 Canal (approximately 1 mile south). The Grassy Flats area is on the eastern shoreline of LWL, east of the Snook Islands. The upland area to the east is a private golf course with an armored shoreline. The golf course was likely created using dredge sediment from the lagoon.

The Grassy Flats project created 13 acres of critical wetland habitat using 52,000 cy of sand to create two intertidal islands. A high-speed conveyor belt (“Sand Shooter”) was employed to evenly distribute sand across the large dredge hole so existing muck would not be displaced, creating a wave, during island creation. After the islands were established (**Figure 4-2**), a group of volunteers planted saltmarsh cordgrass and red mangroves leaving two open areas of high ground for nesting shorebirds.

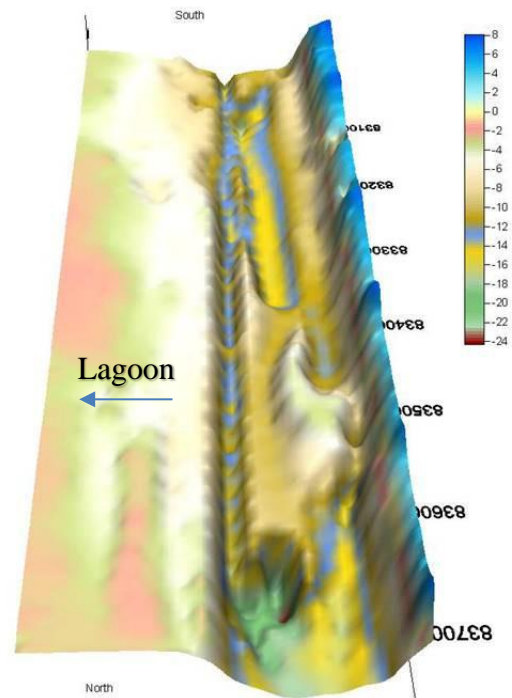


Figure 4-1 - Snook Island Pre project Bathymetry



Figure 4-2 – Grassy Flats Prior to Planting

4.3 Potential Project Sites

The sedimentation (muck) analysis showed a direct correlation between dredge hole depth, muck thickness, density of fines, and loss of habitat. This indicates that the presence of thick muck suggests significant habitat loss at, and around, these dredge holes (**Figure 4-3**). The Non-federal sponsor provided six existing dredge holes within the central portion of the lagoon: Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove (**Figure 4-4** and **Figure 4-5**). Of these, Currie Park and El Cid are located north of C-51, and the other four sites (Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove) are located south of C-51. Each potential site has unique conditions, as outlined in **Table 4-3** and shown in their subheadings below.

The wave heights and peak wave periods for typical wind conditions discussed earlier for each of the six sites are shown in **Table 4-4**. Generally, wave heights for typical wind conditions range from 0.5 to 1.0 ft and peak periods range from 1 to 2 seconds.

Table 4.3 - Metadata of Potential Project Sites

Site Name	Dredge Hole Depth (ft)	Muck Depth (ft)	Distance from C-51 (N/S)	Site Acreage (ac)	Dredge Hole Acreage (ac)
Currie Park	-7.5 to -21.5	0 – 2.76	6.18 mi(N)	85.8	60.5
El Cid	-6.5 to -19.5	0 – 1.75	3.16 mi(N)	17.5	12.05
Tarpon Flats	-4.5 to -19.5	0 – 1.92	0.24 mi(S)	18.0	16.8
Snook East	-3.5 to -7.5	0 – >5.56	1.6 mi (S)	37.9	20.9
Bryant Park	-7.5 to -9.5	0 – 2.46	2.52 mi(S)	39.0	38.8
Bonefish Cove	-2.5 to -13.5	0 – 4	2.78 mi(S)	127.3	61.6

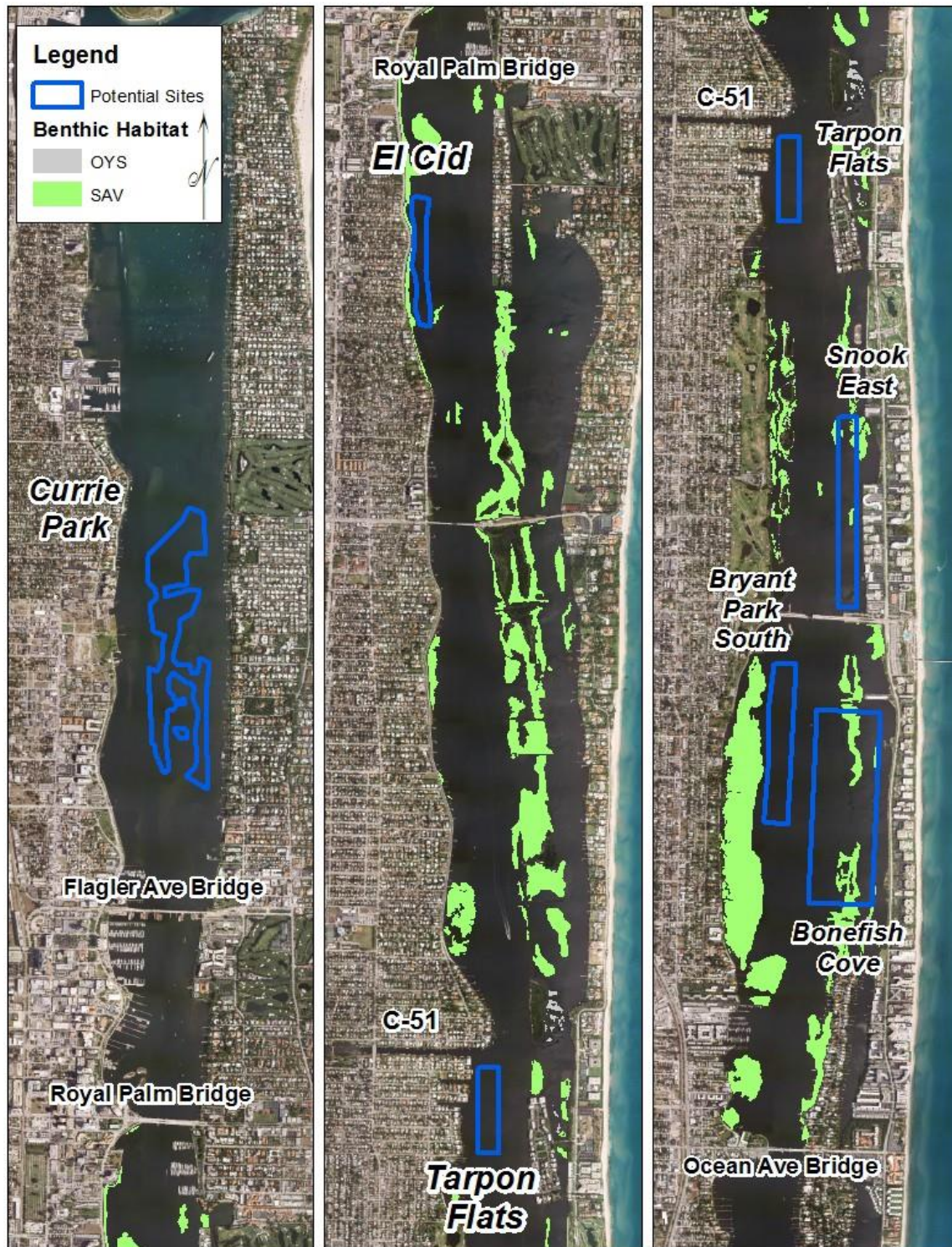


Figure 4-3 – LWL Habitat Loss



Figure 4-4 – 2002/ 2003 LWL Bathymetry Survey

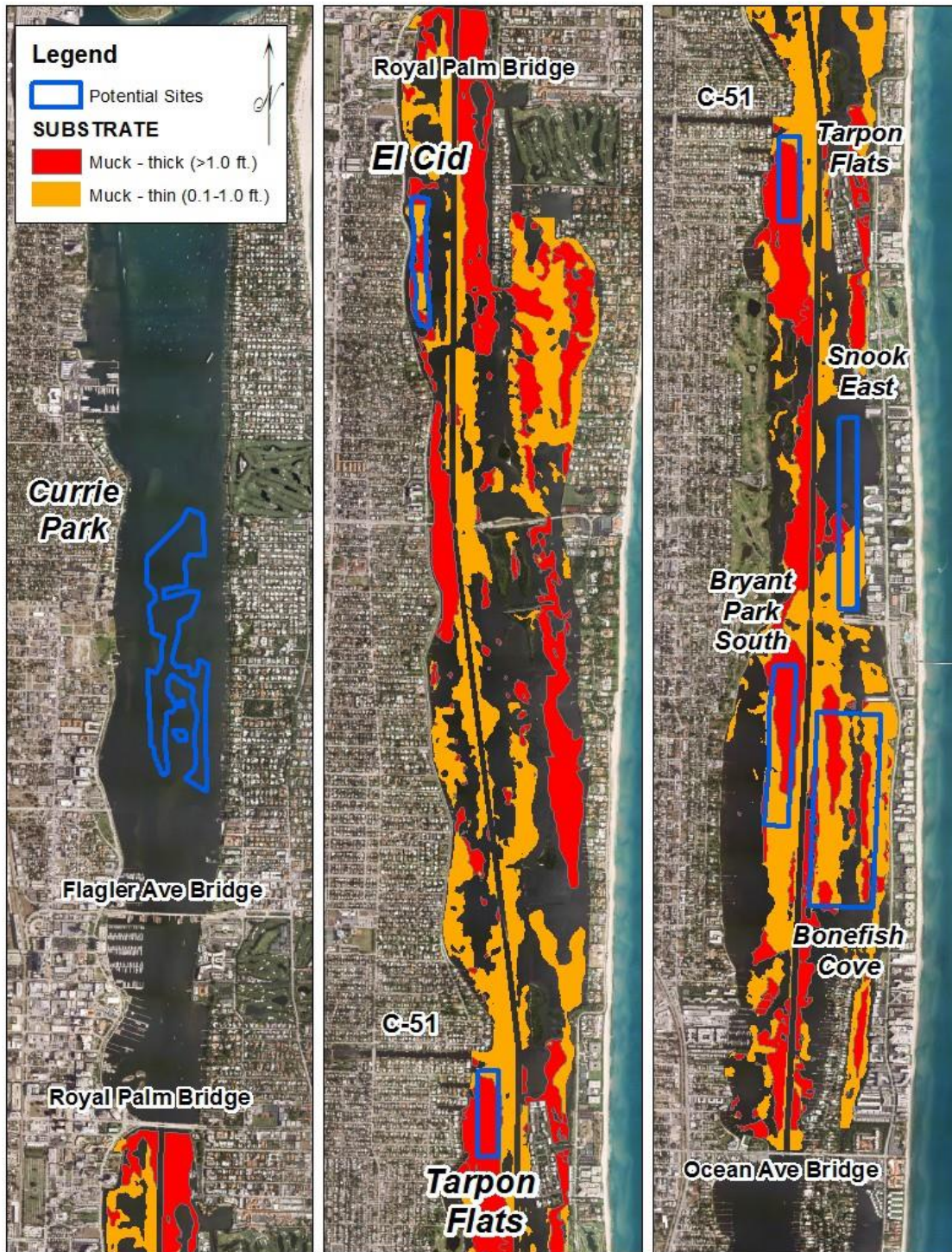


Figure 4-5 Six selected Ecosystem Sites within LWL with muck thickness (Cordy 2011)

Table 4.4 - Alternative Site Shallow Water Wave Growth- Typical Condition

Alternative Site	Fetch		Depth (ft)	Wave Height (ft)	Peak Wave Period (sec)
	Dir	Length (miles)			
Currie Park	North	2	10	0.9	1.9
	East/West	0.2	10	0.3	0.9
	E/W total	0.4	8.5	0.4	1.1
	South	3	7.7	1.1	2.0
El Cid	NE	3	9.5	1.1	2.1
	SE	0.75	7	0.6	1.4
	SSE	3	6	1.0	2.0
Tarpon Flats	NE	1	6	0.7	1.5
	SSE	1	8.5	0.7	1.5
Snook East	NNW	1.25	10.5	0.8	1.6
	NW	0.3	11	0.4	1.1
	SSW	2	8	0.9	1.8
Bryant Park	NNE	1	7.5	0.7	1.5
	NE	0.4	6.5	0.4	1.1
	SSE	1	7.0	0.7	1.5
	SE	0.4	8.5	0.4	1.1
Bonefish	NNW	2.5	10.5	1.0	2.0
	NW	0.45	6	0.5	1.2
	SSW	1.5	8.5	0.8	1.7
	SW	0.5	6	0.5	1.2

(Wind speed = 20 knots , Duration = 6 hours)

4.3.1 Currie Park

Currie Park dredge hole, the northernmost of the potential project sites, is the second largest dredge hole within LWL and is east of the IWW. The project site is approximately six miles north of C-51 canal. The seismic survey conducted by Dial Cordy (2011) did not extend north of Royal Palm Bridge, and thus overall sediment characterization is not available (**Figure 4-6**). In November 2014, USACE collected sediment probes within the Currie Park dredge hole to identify areas where muck is present. Sixteen (16) probes and four (4) grab samples were collected in this area; fourteen (14) probes encountered muck. Muck thickness varied from 0 to 3 feet thick, averaging 2.1 feet with a median of 0.3 feet. Other materials encountered in the site are silt (ML) and silty sand (SM).

East of the placement area, is a 2.2 mile armored residential coastline within the Town of Palm Beach which has various sheet pile walls and limited coastal vegetation. Residential docks exist which dock boats ranging from recreation boats to mega yachts. The Town of Palm Beach ranks among the most expensive real estate markets in the CONUS.

To the west of the project, is a 9.5-acre city Park within West Palm Beach Park, named Currie Park after the former mayor of West Palm Beach. The park offers walking paths along the lagoon, boat ramps, tennis courts, a playground for children, and a maritime museum. There are two (2) two-lane boat ramps and two (2) single-lane boat ramps. There is a fishing pier and an open grassy area for lounging or picnicking, and a Martin Luther King, Jr. memorial.

4.3.2 El Cid

The El Cid dredge hole (**Figure 4-7**) is west of the IWW and is located along the western shoreline of South Flagler Drive. South Flagler Drive is a 1.25 mile shoreline drive with an armored shoreline comprised of bulkhead - revetment. The El Cid dredge hole is located 3.7 miles north of C-51, and between crossing streets Barcelona Road to the north and Avla Road to the south (<0.5 miles). El Cid is a historic district within the City of West Palm Beach, located just south of the Downtown area.

USACE sediment probes collected in 2014 indicated that there are isolated areas where muck is present in the El Cid dredge hole. Six (6) probes and two (2) grab samples were collected in this area; four (4) probes encountered muck. Muck thickness varied from 0 to 3.8 feet thick, averaging 0.8 feet with a median of 0.5 feet. Material encountered in the site is silt (ML).

4.3.3 Tarpon Flats

The Tarpon Flats dredge hole (**Figure 4-8**) is located just south of the C-51 canal and west of the IWW. Adjacent upland areas to the west of Tarpon Flats are comprised of residential community within the Town of Lake Worth. The upland area was built using material from the Tarpon Flats dredge hole to construct two finger channels. Recently collected muck probes by Palm Beach County indicate that there is at least 2 feet of muck present at this location.

4.3.4 Snook East

Snook East (**Figure 4-9**) is not an easily defined dredge hole as compared to the previous mentioned areas. It is a lagoon parallel boundary area with a centrally identifiable dredge hole. Snook East is 1.6 miles south of C-51 and east of IWW. The Town of Palm Beach is east of the boundary area where upland areas is comprised of Condominiums at the southern boundary and

pocket area to the north. The pocket area has a low manicured vegetative shoreline with a fronting beach where visitors and locals alike can enjoy this portion of the lagoon for its sunsets. Recently collected muck probes by Palm Beach County indicate that there is at least 5.5 feet of muck present at this location.

4.3.5 Bryant Park South

Bryant Park South, the southernmost potential project site, is a shallow but long narrow dredge hole that does not have easily definable boundaries. The project site provided is 2.5 miles south of C-51 (**Figure 4-10**). The dredge hole is longer than the area provided, and deeper muck areas exist generally within the area provided. The Bryant Park South site is located south of Lake Ave Bridge, east of IWW, and south of the recent living shoreline constructed in Bryant Park by the PBC. LWL begins to widen south of Lake Ave so the dredge hole extends further into the lagoon than previous areas. West of the area is a residential fronting property with various beach heads and vegetative residential shorelines. At the northwestern end, a public park exists, Bryant Park, which is a 3,000 foot armored lagoon shoreline park with two (2) two-lane boat ramps with docks and trailer parking. Recently collected muck probes by Palm Beach County indicate that there is at least 2.5 feet of muck present at this location.

4.3.6 Bonefish Cove

Bonefish Cove, the southernmost potential project site, is south of Lake Avenue Bridge, but east of the IWW and 2.7 miles south of C-51. Bonefish Cove is directly across the IWW from Bryant Park site and has a similar long narrow shallow dredge hole (**Figure 4-10**). East of Bonefish Cove is Ocean Boulevard, which is a lagoon fronting parallel roadway with pedestrian access to the lagoon and walking paths. Other than the park area, the shoreline to the east has a revetment with vegetation along the low areas of the lagoon. A finger island does exist to the north, which juts westward towards the lagoon, likely created by dredged lagoon material. Lastly, east of Ocean Boulevard, are very large condominium complexes. Recently collected muck probes by Palm Beach County indicate that there is 0 to 4 feet of muck present at this location.

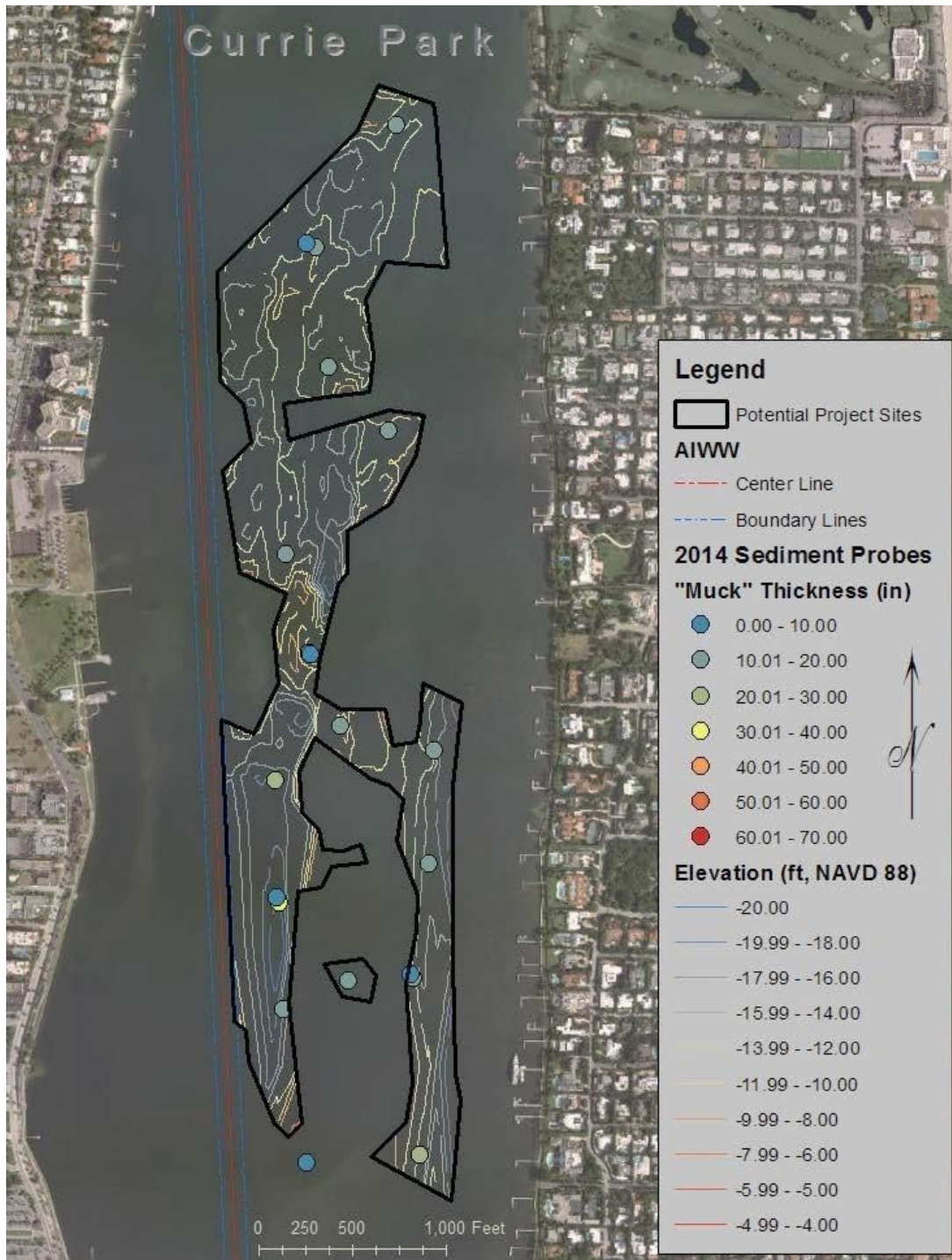


Figure 4-6 – Currie Park Site

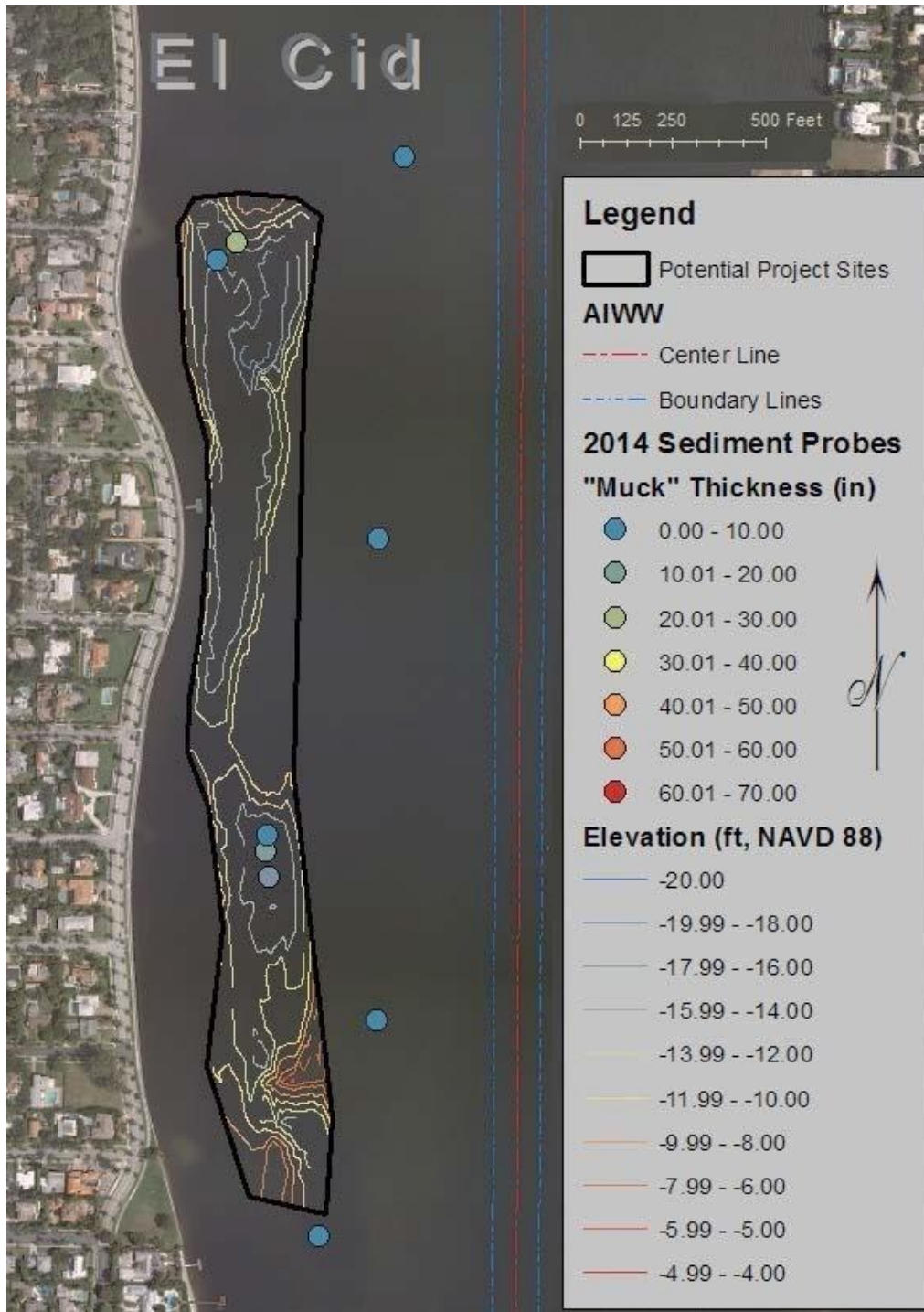


Figure 4-7 – El Cid Project Site

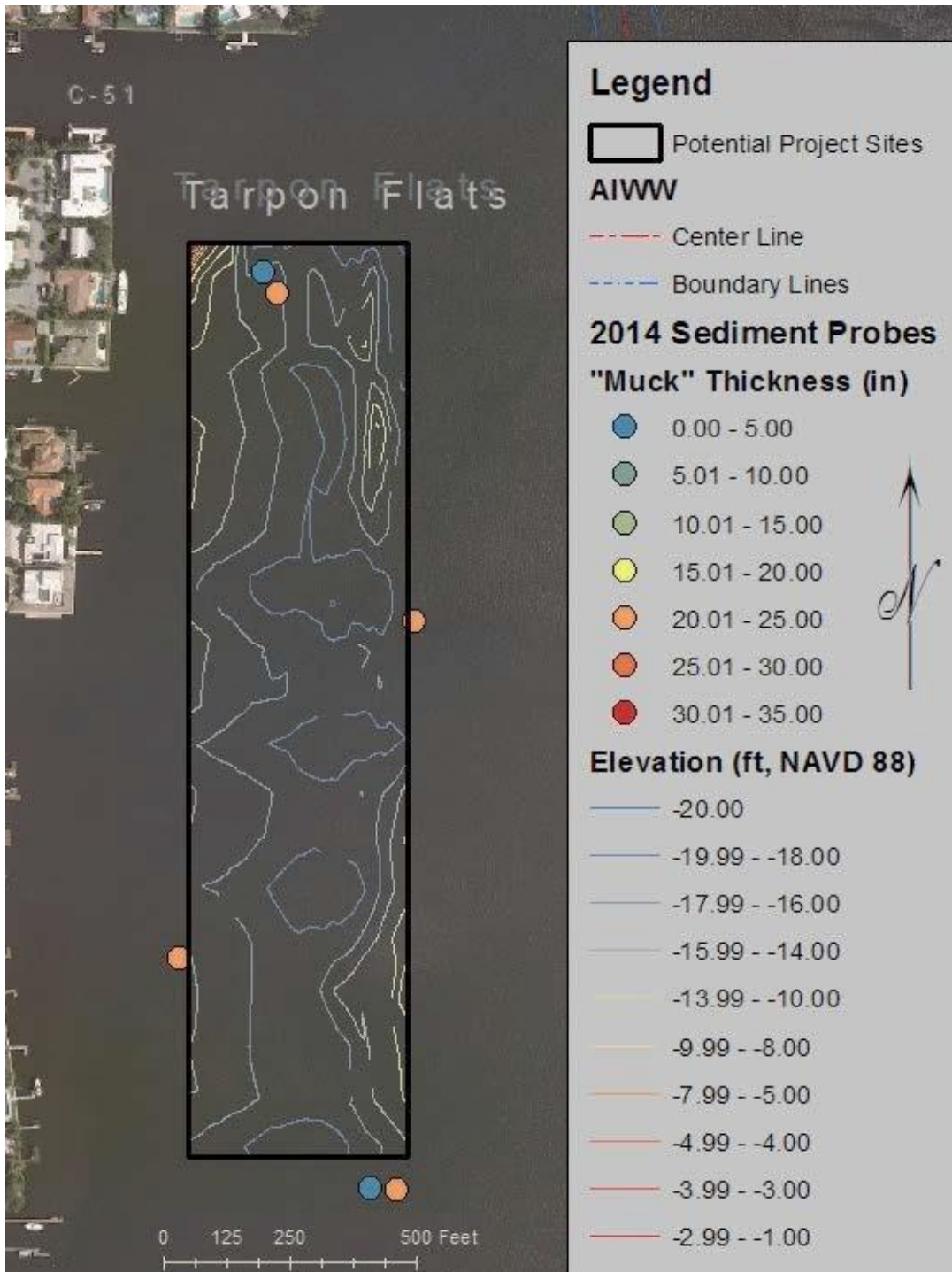


Figure 4-8 – Tarpon Flats Project Site

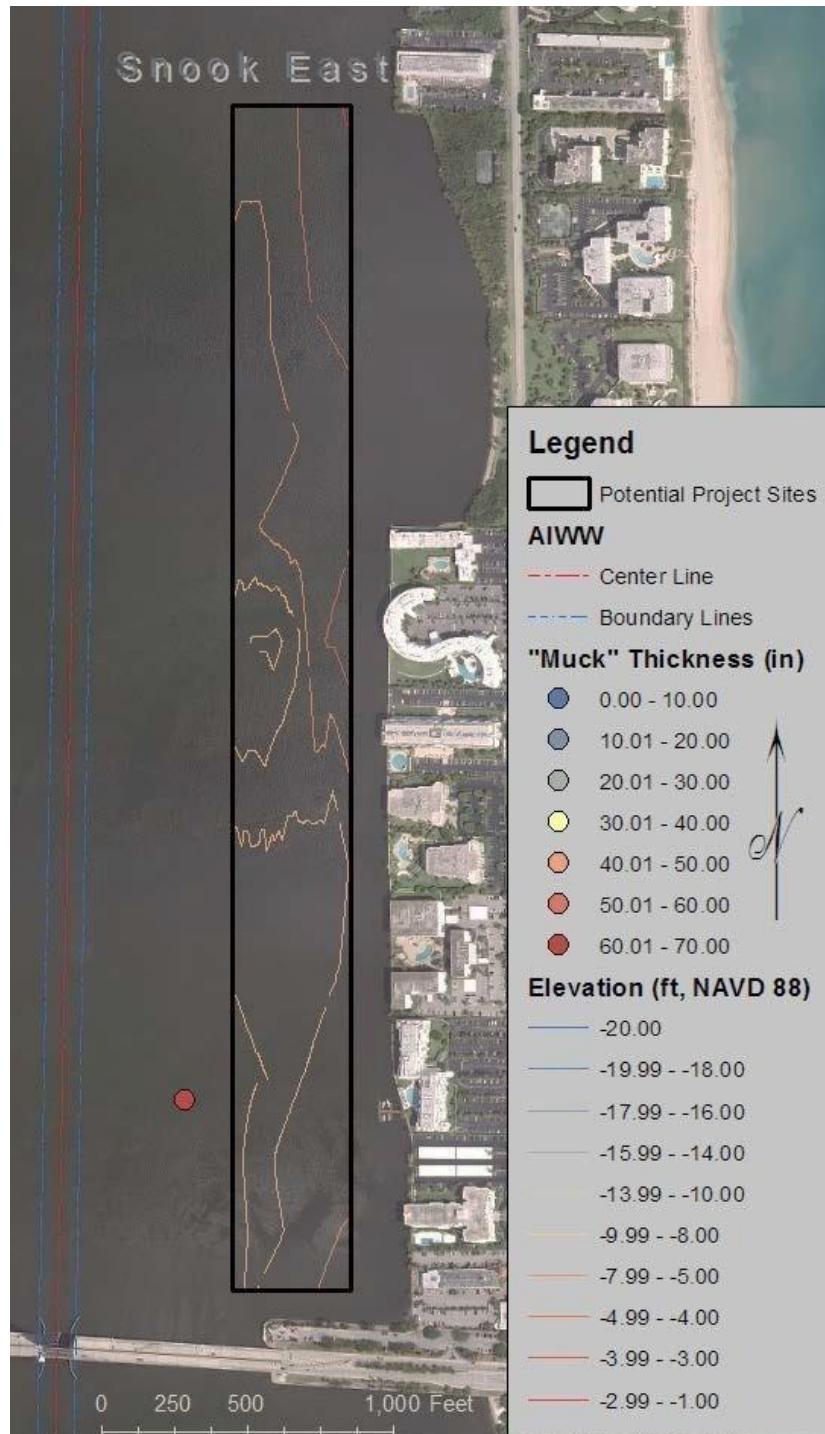


Figure 4-9 – Snook East Project Site



Figure 4-10 – Bryant Park and Bonefish Cove

4.3.7 Potential Sites Determination

Qualitatively, projects conducted at the Currie Park, Tarpon Flats, and Snook East areas could have negative results if an ecosystem restoration area would be placed in these areas, as large amounts of muck that have deposited in the dredge holes over time could be displaced, creating a wave. Currie Park is not a viable option for restoration because it is too far north of C-51 where most of the freshwater flow exists. Additionally, creating an intertidal restoration in the middle of the lagoon could be more hazardous to wildlife and people than areas closer to the shoreline. The Tarpon Flats area is subject to high fluctuations of salinity and flow because it is near the mouth of C-51 (**Figure 4-8**). Also, the lagoon is narrow in this location due to the presence of John's Island to the north and Ibis Isle to the east. Tidal and wind driven currents, in addition to freshwater flow from C-51, are already high in this area would be exacerbated by putting another feature in this location. Lastly, the Snook East location is not viable because the pocket area previously mentioned could reduce the flushing of lagoon waters in this location, which would likely increase water impairment on the eastern shore. Flushing of water occurs with tides and wind generated waves within the lagoon. Winds, as previously noted, are typically from the east and will be diminished due to the high rise condominiums that are further to the east. Therefore currents in this location would likely decrease and not have enough energy to flush out water levels during normal tidal cycles.

The wind rose data provided in **Figure 2-5**, typical wave data shown in **Table 4-4**, and distance from C-51 were utilized to assess the remaining three areas: El Cid, Bryant Park, and Bonefish Cove. The western¹ dredge holes of the lagoon (e.g., El Cid and Bryant Park) would benefit from a Snook Island type of restoration project because of the wave shielding affect the island type creation would provide. El Cid has a higher wave climate than the other five potential project sites (**Table 5-1**). The shoreline west of El Cid is armored to protect the lagoon parallel access road. The creation of islands at El Cid and Bryant Park would protect the shoreline to the west, but the eastern area of the potential site would be subject to the swell/ storm waves in additions to wind driven waves and boat wakes, needing protection from riprap. Directly west of the Bryant Park area are residential beachheads, which face the lagoon. Flushing behind these proposed areas will likely be problematic due to decreased flow like at Snook East. Lastly, the Bonefish Cove area provides the least restrictive site because of the large area it occupies in the lagoon, as compared to El Cid and it is not directly near boat ramps like at Bryant Park. While

¹ Western and Eastern refers to the location of the dredge hole in relation to the IWW.

all three potential sites experience boat wake, Bonefish Cove would have fewer fetch issues than El Cid and Bryant Park due to the presence of the high rise condos to the east of the project site.

Recruitment of seagrass should occur naturally at all three locations. El Cid is in close proximity to Lake Worth Inlet's influence, and may not have the high changes in salinity that Bryant Park and Bonefish Cove experiences. However, Bonefish Cove and Bryant Park are located in areas that are impacted by thicker muck deposits than El Cid; these sites would environmentally benefit by having a project within these locations due to the impacts of muck on lagoon habitat. Bryant Park has a boat ramp and the risks with creating an ecosystem project could impact the public boating in this area; Bonefish Cove is in the center of the lagoon and has no risk to boating. Lastly, established seagrasses exist to the southwest of Bryant Park, but the Bonefish Cove site is mostly devoid of seagrasses, based on a 2013 survey. Therefore, as far as alternative selection criteria, El Cid and Bonefish have the highest return with the least amount of impact.

4.4 Sediment Source: Peanut Island

Peanut Island was used as a sediment source for Snook Islands and Grassy Flat projects. Peanut Island was created in 1918 as a result of the creation of Lake Worth Inlet, and fill placement from numerous dredging projects occurring in LWL and Lake Worth Inlet. U.S. Army Corps of Engineers' records show that maintenance of the Lake Worth Inlet between 1929 and 1993 has resulted in the disposal of over 1.2 million cy of dredged material on Peanut Island, as the sand was mixed with rock and/or finer sediments and not suitable for beach disposal. Since 1934, the Corps has maintained the Palm Beach Harbor Navigation Project and has used Peanut Island as a disposal site for the maintenance of the IWW, turning basin, jetties, and inlet revetments.

4.4.1 Brief History of Peanut Island

In 1918, Peanut Island was called Inlet Island and was only 10 acres; Peanut Island, thus named for plans to use the island as a terminal for shipping peanut oil, is now 79 acres and contains a dredged material management area (DMMA), recreational facilities, historical interests, and military interests. The U.S. Coast Guard opened a lifesaving station and boathouse on Peanut Island on November 1, 1936 (placed in service in 1937), which remained active until it was moved in 1995; the station is now part of the Palm Beach Maritime Museum. Additionally, the Navy Seabees built a secure shelter and command post on Peanut Island for President John F. Kennedy in 1961, which was decommissioned in 1964; the bunker is also a part of the Palm Beach Maritime Museum (U.S. Coast Guard, 1997). In 1984, PBC and the Port of Palm Beach made an agreement to maintain the island; PBC, the Port of Palm Beach, and the Florida Inland

Navigation District (FIND) presently hold Peanut Island. The island's perimeter is for Palm Beach County public use; FIND, the Port of Palm Beach, and the Palm Beach Maritime Museum utilize the interior of the island (**Figure 4-11**).



Figure 4-11 – Oblique aerial of Peanut Island showing various uses.

4.4.2 Summary of Data from Peanut Island

Prior to recent construction activities involving eco-restoration of Peanut Island, or offloading material from the DMMA, a Phase 1 investigation was conducted by Palm Beach County in 1997 (EN Attachment D). The conclusions of this investigation revealed no evidence of hazardous materials based on the American Society of Testing and Materials (ASTM) Standard 1527-94 based on a site inspection and review of all available information, and did not recommend additional investigations of the area for soil or groundwater contamination. HTRW is not a concern due to the fact that the fill material from the Peanut Island DMMA is basically high quality sand from nearby dredging activities within the region. During the dredging process, most the fines are washed out leaving the coarse silica particles (quartz sand (SP)) in the DMMA. Currently the sand from the Peanut Island DMMA is been used to restore low laying areas and other minor permitted restoration projects.

Regarding HTRW sources in sediment; sediments impacted by receiving end of pipe discharge from an industrial process or the combined discharge from an industrial zone, could become highly contaminated, and EPA maybe would declare them hazardous. At that point, the contaminated sediment will be regulated as a hazardous waste under RCRA. This is not the case for this project.

The fact is that the IWW contains no ports, and receives no discharge from industrial facilities or Brownfields projects. The former sediments found in the Peanut Island DMMA were part of the IWW dredging and fill activities permitted by the State. There is no concern for the use of sand (former dredged material) from Peanut Island DMMA for this small project."

The sediments within the FIND DMMA were dredged from Lake Worth Inlet and the IWW within LWL. The in situ sediments (prior to dredging) consisted of gray to brown sands, fine sands with silt, and sands with gravel to sand sized shell and shell fragments. After dredging the sediments and placing them in the DMMA, the finer grained sediments were further washed out due to natural weathering processes, leaving a light gray fine grained sand with some shell and gravel. Detailed geotechnical data is provided in (EN Attachment E).

4.5 Rough Order of Magnitude (ROM) Estimate

PDT needed rough order of magnitude (ROM) estimates to rule out costly alternatives that are outside the financial capacity of CAP. All ROM estimates follow the ER 1110-2-1302 guidelines and are the least accurate estimate with an accuracy range between -25% to +25% based on the quality of input and historical provided to the Cost Engineer. For LWL, ROM estimates were conducted on three alternatives. Alternatives 1 & 2 focused on island creation and sand capping at the Bonefish Cove and El Cid potential project sites. Alternative 3 focused on dredging three (3) existing muck sites and capping those areas with sediment from peanut island.

Early in the planning process for LWL CAP, the PDT discussed the construction of a sediment trap within the vicinity of C-51. However, the likelihood of the sediment trap being maintained after construction is not likely due to cost of excavation and treatment of dredged sediments prior to acceptance at a disposal facility. This is the same reason the sediment trap constructed by PBC DERM and SFWMD upstream of the S-155 structure has not been maintained.

Furthermore, the surveys of the sediment trap illustrate that once muck has accumulated within the sediment trap, muck can be displaced back into the water column. Lastly, the lagoon cross-sectional area near C-51 is narrow so velocities near or adjacent to C-51 are likely higher than other areas with wider portions of the lagoon. The increase velocity would continually re-suspend gathered muck in the sediment trap. Therefore, constructing a sediment trap would not benefit the LWL due to lack of maintenance of the trap, continued inflow of freshwater laden with sediment, and high current velocities re-suspending the muck in the lagoon.

4.5.1 Oyster Structures

For oyster recruitment, the PDT used relief structures familiar to the team for oyster habitat (i.e., pre-fabricated artificial reef modules). Pre-fabricated artificial reef modules are self-sustaining units made of a neutral concrete mix for the successful recruitment of various marine organisms (i.e., oysters). These structures come in variety of sizes but the team chose the larger pre-fabricated artificial reef modules because they provide safe havens for smaller juvenile fish from predators.

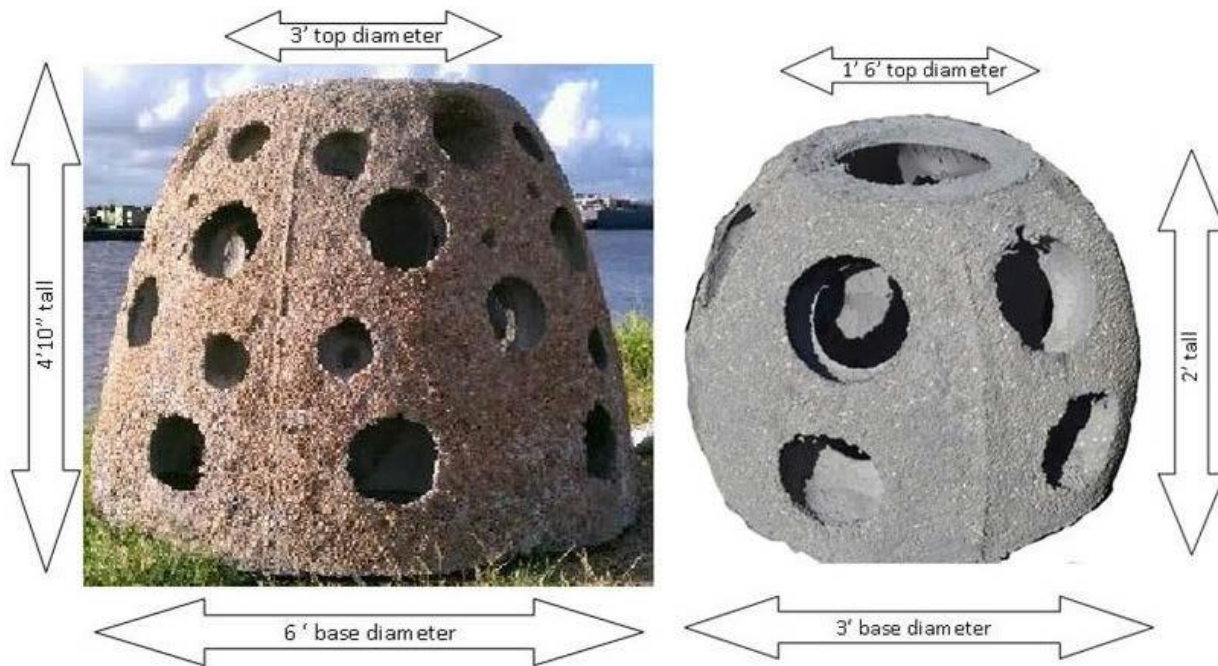


Figure 4-12 – Pre-fabricated artificial reef modules

4.5.2 Alternative 1 – Island Creation

The objective of this alternative is to raise the existing bathymetry to the intertidal range and cover the existing muck material with clean sand. Fill material to be used for the project will be excavated and transported from Peanut Island – the same sediment source used for creating the Snook Islands and Grassy Flats. Peanut Island is 6.0 miles and 11.8 miles away, respectively, from the El Cid and Bonefish Cove sites. The goal of this alternative is to create three upland islands for mangrove habitat that will be protected with riprap and internment oyster reefs in the form of Pre-fabricated artificial reef modules scattered around the islands. The construction effort will consist transporting the fill material from Peanut Island to the selected project site to create three different substrate levels. The base or bed of the island will be raised to - 5.5 feet NAVD88, which will be achieved on a 12.5 % slope (1 foot vertical to 8 feet horizontal) from existing bathymetry and offset from the IWW right-of-way. The interior base of the island which is where the pre-fabricated artificial reef modules will be placed will be elevated to - 3.5 feet NAVD88 on a 4% slope (1 foot vertical to 25 feet horizontal), approximately one foot below mean low water (MLW), or - 2.5 feet NAVD88. To complete the island creation project, three mangrove islands will be established to -0.5 feet NAVD88 on a 17% slope (1 foot vertical to 6 feet horizontal). In addition, the project would include the installation of riprap for shoreline protection and island stabilization. Riprap sizing is assumed to be similar to the type constructed

at the Snook Islands and Grassy Flats projects (2’-3’ limestone boulders). The post-construction features will include the creation of red mangrove habitat and installation of Pre-fabricated artificial reef modules for oyster reefs. Seagrass will not be planted because it is anticipated the elevated substrates would provide enough benefit for natural seagrass recruitment. The prominent species of seagrass in LWL, *Halophila* species, recruits rapidly throughout the lagoon. **Table 4-5** provides the actual values used in the ROM for El Cid – Alternative 1A and Bonefish Cove – Alternative 1B. These values were attained using the Morgan and Ecklund bathymetry survey. **Figure 4-13** illustrates the plan layout for Alternative 1 for both locations, and **Figure 4-14** is typical cross-section for Bonefish Cove.

Table 4.5 – Alternative 1 Cost Line Items

Line	Line Item Description	Alt. 1A El Cid Qty.	Alt. 1B Bonefish Qty.	Unit
0001	Mobilization & Demob	1	1	LS
0002	Pre/Post- Construction Survey	1	1	LS
0003	Excavate & Transport Fill Material	191,033	374,306	CY
0003A	Spread Sand	191,033	374,306	CY
0004	Riprap (D50 Size 2-3 FT)	4,102	5,416	TON
0005	Geotextile	3,000	3,000	SY
0006	Oyster reef rock (Pre-fabricated artificial reef modules)	40	56	EA
0006A	Reef Rock Transportation/ Load/Installation/Crane/Diver	1	1	LS
0007	Mangrove Area	4.58	9.37	ACR
0008	Turbidity Curtains (Supply/Install/Maintain)	6,000	6,000	FT
0008A	Turbidity Monitoring/Reporting	1	1.00	LS
Estimated ROM Costs		\$5,900,000	\$10,500,000	

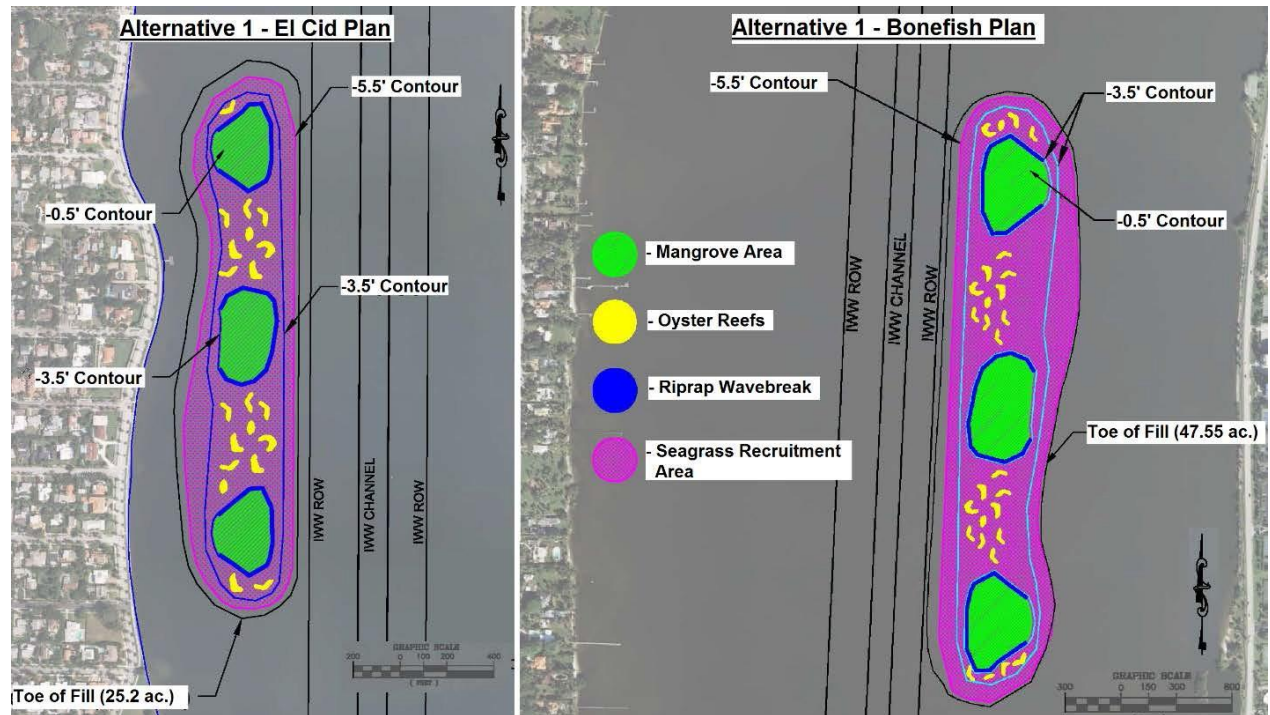


Figure 4-13 – Plan View of Alternative 1 (Island Creation)

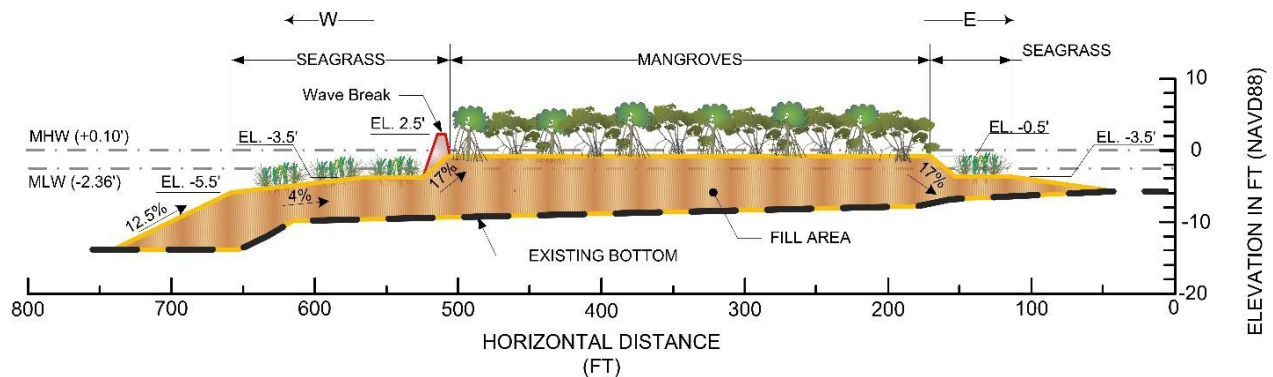


Figure 4-14 – Cross-section of Alternative 1 (Island Creation)

4.5.3 Alternative 2 – Sand Capping

Alternative 2 will have a similar habitat footprint as Alternative 1; sediment would also be excavated and transported exported from Peanut Island, but alternative 2 has a few differences. First, transported sediment would be remobilized into a mechanical shooter to thinly distribute the sediment over the project area to avoid muck displacement for the base substrate at – 5.5 ft NAVD 88. This technique was used for the creation of the Grassy Flats project with no muck displacement. Once the base substrate is created, then dump and fill technique will create the tier

2 substrate to - 2.5 feet NAVD88. The second difference between Alternative 2 and Alternative 1 is the absence of mangrove islands, which will be replaced with Pre-fabricated artificial reef modules, so the sand capping method would not require the third tier substrate at elevation - 0.5 feet NAVD88. The elevations for the base and second tier are exactly the same as island creation, thus the sediment quantity needed will be less than the island creation. The goal of this alternative is to cap the muck in place, create oyster reef habitat, and provide habitat for natural seagrass recruitment. **Table 4-6** provides the actual values used to determine the sand capping alternative ROM for the El Cid – Alternative 2A and Bonefish Cove – Alternative 2B. These values were attained using the Morgan and Ecklund bathymetry survey. **Figure 4-15** illustrates the plan layout for Alternative 2 for both locations, and **Figure 4-16** is typical cross-section for Bonefish Cove.

Table 4.6 – Alternative 2 Cost Line Items

Line	Line Item Description	Alt. 2A El Cid Qty.	Alt. 2B Bonefish Qty.	Unit
0001	Mobilization & Demob	1	1	LS
0002	Pre/Post- Construction Survey	1	1	LS
0003	Excavate & Transport Fill Material (6 Miles one way)	150,000	300,000	CY
0004	Sand Broadcasting	150,000	300,000	CY
0006	Oyster reef rock (Pre-fabricated artificial reef modules)	40	56	EA
0006A	Reef Rock Transportation/ Load/Installation/Crane/Diver (Assuming 20 Miles)	1	1	LS
0007	Pre-fabricated Artificial Reef Modules	9	9	EA
0008	Turbidity Curtains (Supply/Install/Maintain)	6,000	6,000	FT
0009	Turbidity Monitoring/Reporting	1	1	LS
Estimated ROM Costs		\$6,200,000	\$11,200,000	

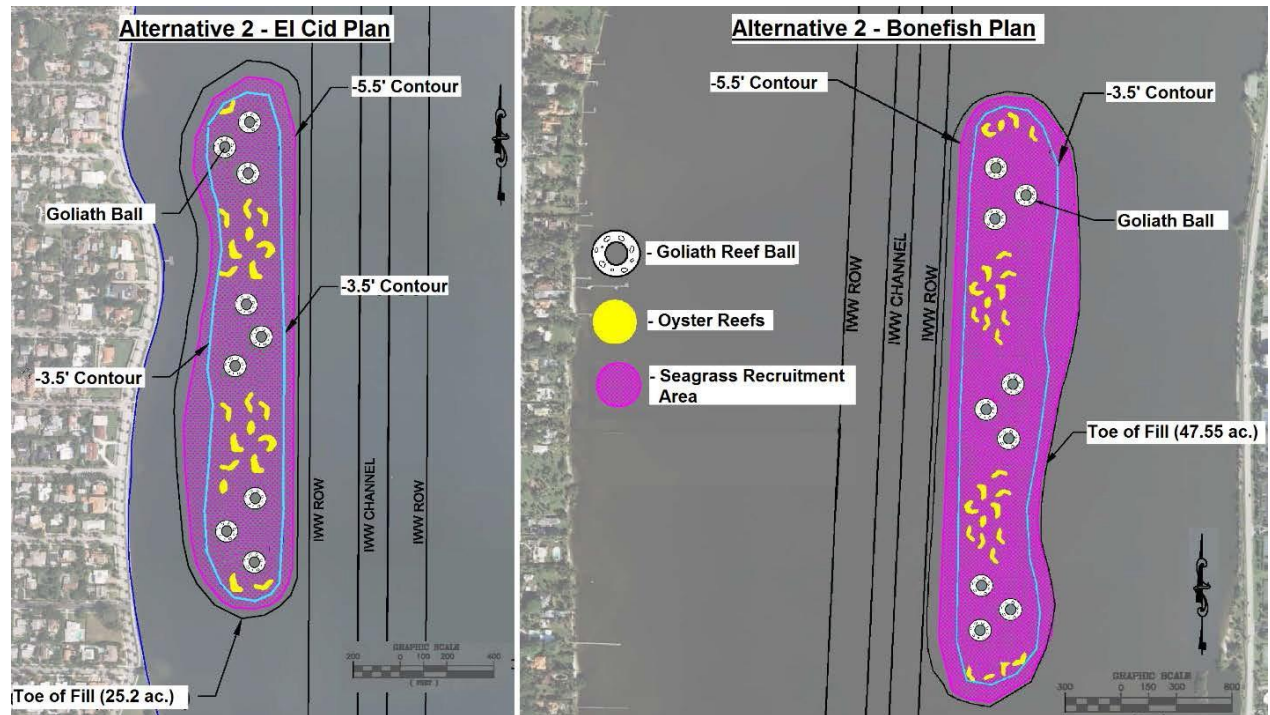


Figure 4-15 – Plan View of Alternative 2 (Sand Capping)

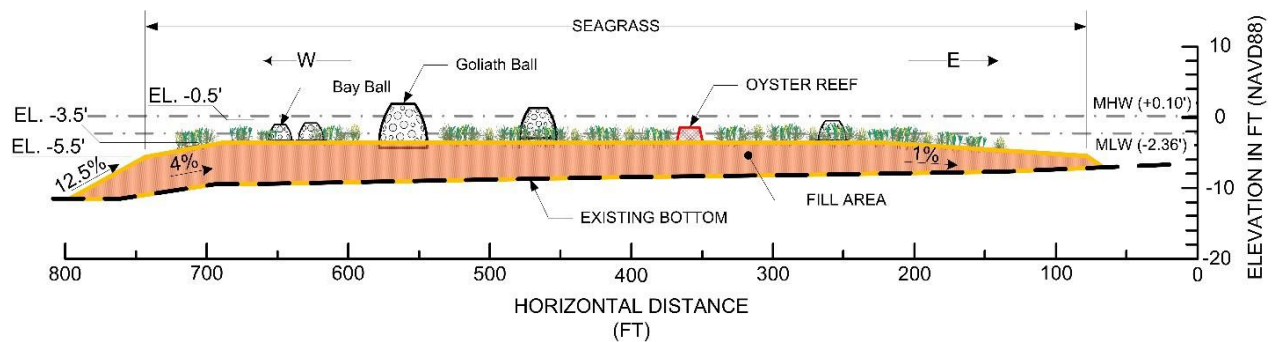


Figure 4-16 – Cross-Section of Alternative 2 (Sand Capping)

4.5.4 Alternative 3

During the alternative selection phase, additional sites were identified within the lagoon that would benefit from the removal of muck. Three (3) dredge sites were chosen using the Dial Cordy 2011 study and Morgan and Ecklund 2012 survey (**Figure 4-17**). Each location would be dredged to remove the existing muck; where the materials would be transported to Peanut Island for dewatering, processing and disposal at a local facility. Once muck was removed, the area would be capped with coarser grain sands excavated from Peanut Island to elevation - 3.5

feet NAVD88. Pre-fabricated artificial reef modules would be placed intermittently within the elevated platform (**Figure 4-12**).

Table 4.7 – Alternative 3 Metadata and Cost Line Items

		Alt. 3A Muck_1512	Alt. 3A Muck_1525 N	Alt. 3A Muck_1525S	Unit
Metadata	Dredge Hole Depth (ft)	-15'	-5' to -10'	-10' to -15'	n/a
	Muck Depth (ft)	>5'	>5'	<5'	n/a
	Dist. from C-51 (N/S)	4 mi (N)	0.5 mi (S)	1.5 mi (S)	n/a
	Dist. from Peanut Is.	5 mi	9.6 mi	10.5 mi	n/a
	Site Acreage (ac)	22.1	42.5	22.5	n/a
Line	Line Item Description	n/a	n/a	n/a	n/a
0001	Mobilization & Demob	1	1	1	LS
0002	Pre/Post- Construction Survey	1	1	1	LS
0003	Dredge & Transport Muck (Dist. from Peanut)	120,000	200,000	100,000	CY
0004	Disposal Muck Material (Transportation)	120,000	200,000	100,000	CY
0004A	Material Filtration (Dewatering)	120,000	200,000	100,000	CY
0004B	MOD - Tank & Filtration System	1	1	1	LS
0005	Excavate & Transport Fill Material (5 Miles one way)	145,200	261,360	319,440	CY
0005A	Spread Sand	145,200	261,360	319,440	CY
0006	Turbidity Curtains (Supply/Install/Maintain)	4,600	6,000	6,000	FT
0006A	Turbidity Monitoring/Reporting	1	1	1	LS
0007	Oyster reef rock (Pre- fabricated artificial reef modules)	10	10	10	EA
0007A	Reef Rock Transportation/ Load/Installation/Crane/Diver (Assuming 20 Miles)	1	1	1	LS
Estimated ROM Costs		\$7,500,000	\$12,500,000	\$11,500,000	

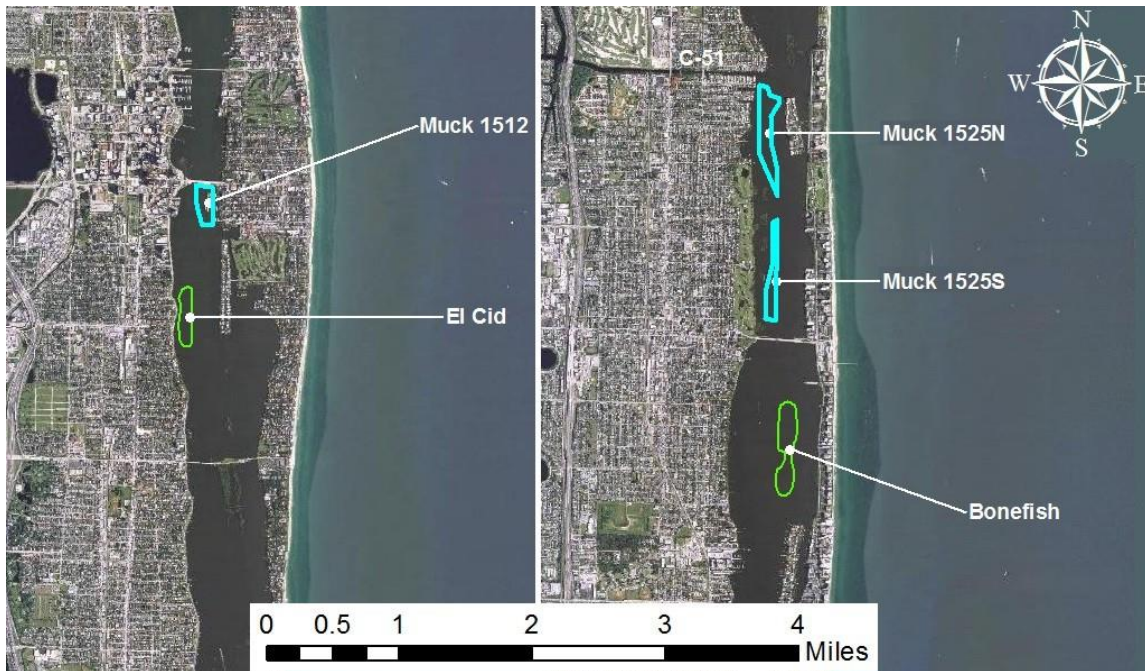


Figure 4-17 – Alternative 3 Project Locations

4.6 Alternative Selection: Summary

Changing or addressing the freshwater flows from C-51 entering LWL is not within the scope of CAP. These freshwater flows cause salinity fluctuations within the vicinity of C-51 canal, but also are the source of continued sedimentation within the central portion of the lagoon. Continued muck accumulation is the root cause of benthic habitat sustainability issues rather than salinity fluctuations. While the muck thickness in the lagoon will continue to increase, constructing a sediment trap will not provide as much ecosystem benefit as would raising the existing elevations of the lagoon to the intertidal range. Countless studies within the lagoon have shown fine sediments do not have a tendency to accumulate in intertidal areas, thus eliminating the construction a sediment trap as a viable option. Alternative 3 focused on dredging and removal of muck and then raising that area above the existing substrate. However, ROM costs show this alternative is too costly compared to Alternatives 1 and 2. The costs are very reflective of the construction of a sediment trap without sand placement. One critical component is that the muck being removed from LWL contains salt, and additional treatment is necessary prior to upland disposal, so this is why items 0004A and 0004B are added to the cost estimate for Alternative 3.

Table 4-8 compares the costs between Alternative 1 and 2, where costs for Alternative 2 (sand capping) are 4 to 6% greater than Alternative 1 (island creation). Therefore Alternate 2 is not as cost effective, nor does it provide as a diverse habitat as the island creation alternative, as this alternative does not include mangrove habitat. Mangroves provide an ecological benefit by consolidating fine sediments and facilitating nutrient uptake within the lagoon. Alternative 1 for El Cid is 44% less than alternative 1 for Bonefish Cove, but by dividing the cost by habitat area to be created at each location, the Bonefish Cove site provides the more ecological benefit than the El Cid site. Therefore, island creation at Bonefish Cove is the preferred alternative for LWL CAP 1135.

Table 4.8 – Side by Side Comparison of Alternatives 1 & 2

Placement Area	El Cid	Bonefish
Habitat Area (acres)	25.2	47.5
Alt 1 Costs (\$)	\$5,900,000	\$10,500,000
Alt 2 Costs (\$)	\$6,200,000	\$11,200,000
Alt 1 Costs per Habitat Area (\$/Acres)	234,126.98	221,052.63
Alt 2 Costs per Habitat Area (\$/Acres)	246,031.75	235,789.47

4.7 Detailed Cost Estimate

Once the preferred alternative was selected, a detailed cost estimate was prepared for Alternate 1B. The construction sequence and methods for island creation at Bonefish Cove is provided in the Cost Engineering Appendix. The Bonefish conceptual design needed changes to the footprint of the project area to be in compliance with National Environmental Protection Act (NEPA). First, the county hired a firm to review the bonefish placement location for historical resources. The survey indicated there were two targets with a high likelihood of significance. Second, a 2013 seagrass survey showed an area of potential seagrass habitat inside the placement area. Planners indicated that even though the survey was old, seagrasses could be within the project’s foot print. **Figure 4-18** is the current design of the Bonefish placement site where quantities of fill needed drop by 7%. The cost appendix also provides a specific breakdown of project costs for the selected alternative based on the preliminary design provided to the Cost Engineer.

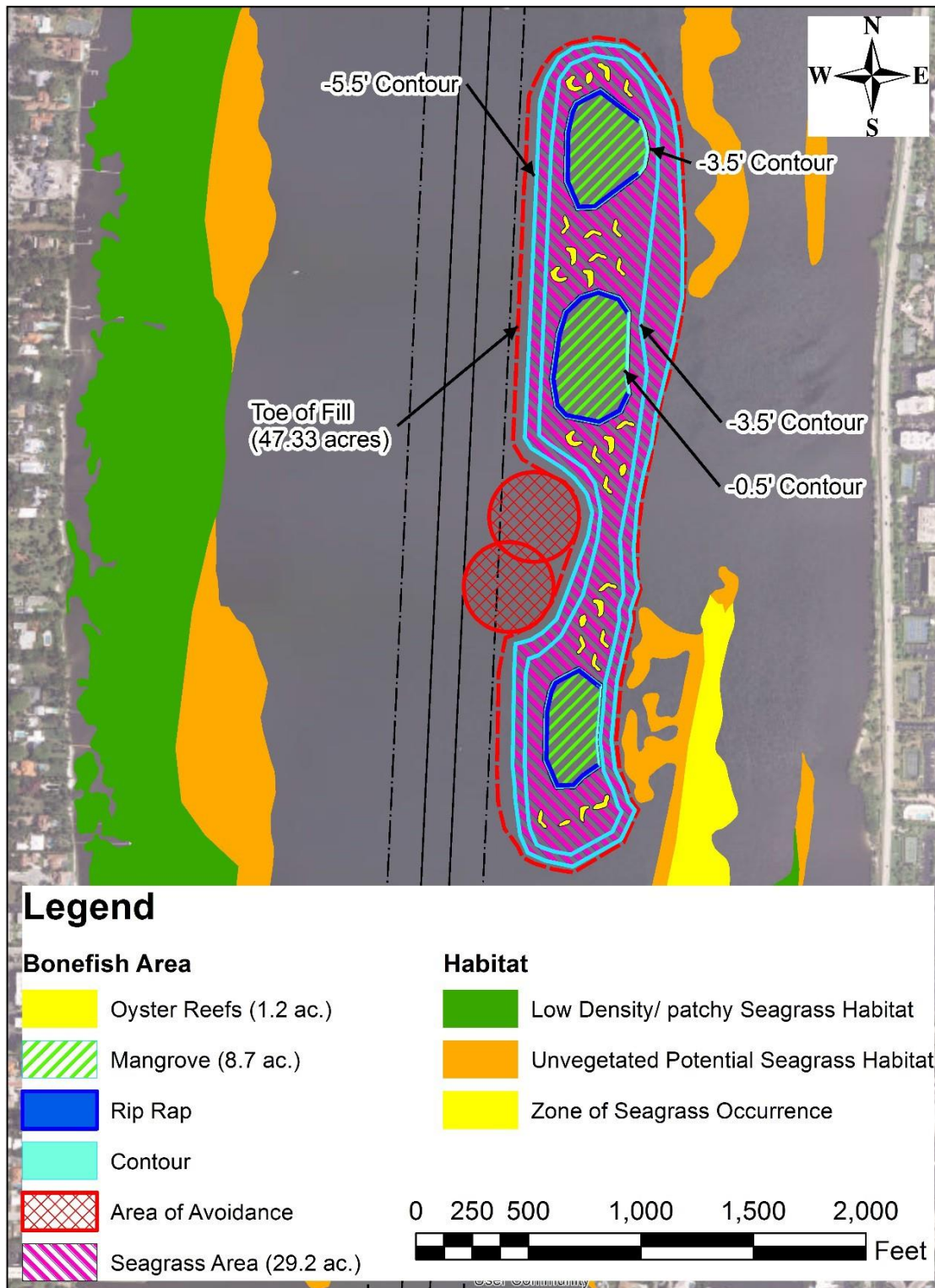


Figure 4-18 – Proposed Bonefish Project Design with Resources

5.1 DESIGN AND IMPLEMENTATION (D&I)

The Design and Implementation needs for the project are outlined in the following subheadings. This heading will provide the Major Subordinate Commander (MSC) an overview of what assumptions were used in the final design shown in **Figure 4-18**.

5.2 Bathymetry

For D&I, Jacksonville District's Operations Division (SAJ-OD) will collect multi-beam surveys at the project site to better estimate the bathymetry of the placement area. Engineer's used bathymetry data collected in 2002/2003 to develop the conceptual design used in the ROM and the final layout shown in **Figure 4-18**. Jacksonville District's Operations Division (SAJ-OD) did a bathymetric study of the lagoon in December 2015 where the 2015 survey was collected in current horizontal (North American Datum of 1983/1990 (HARN)) and vertical datums (North American Vertical Datum of 1988 (NAVD88)). The 2002/2003 survey was collected in HARN, but vertical control was based on the outdated National Geodetic Vertical Data of 1929 (NGVD29). Geomatics staff reviewed the survey and converted the 2002/2003 data to vertically reference NAVD88 using the data relationships provided in Chapter 2.

The problem with the 2015 data is not the data itself, but the survey limits did not extend beyond the southern footprint of Bonefish Cove and barely even captured the El Cid area. The 2015 survey did collect single beam data in high and low frequencies within the lagoon. High frequency pulses have narrow bandwidths and tend to reflect back bathymetric signals of unconsolidated material. Low frequency has a signal bandwidth which typically penetrates the loosely unconsolidated material and returns signals of consolidated sediment bathymetry. This method provides insight to the presence of muck holes.

Engineer conducted volume comparison between the 2002/2003 and 2015 surveys and determined the volume difference within the placement area was 1,000 cubic yards. Engineer also looked into the differences between the low and high frequency data which was about 400 cubic yards. This 12 year span between surveys and low volume difference clearly indicates the area within the placement area has a fairly stable bathymetry. **Figure 5-1** shows the cross-section of the two surveys in relationship to the IWW and the Bonefish placement area. At the IWW, there is little survey difference and 200 feet east of IWW centerline and generally is the current muck hole where 90% of the 2015 to 2002 volume difference mentioned earlier was captured.

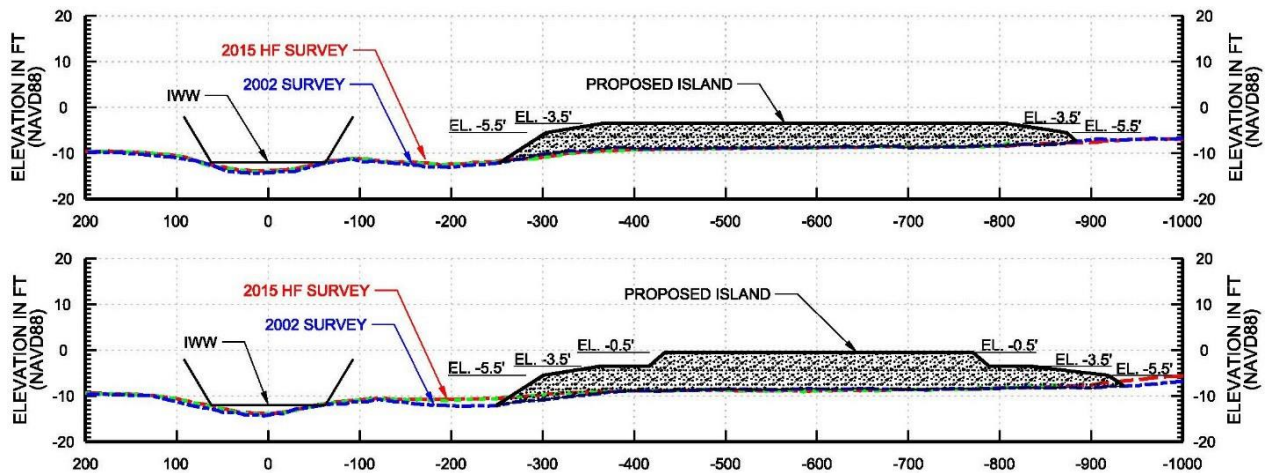


Figure 5-1 – 2002/2003 to 2015 survey comparison at Bonefish placement area

5.3 Turbidity/ Displacement of Muck

A muck wave was observed during construction of the Snook Islands project due to the extreme depth of the hole (**Figure 4-1**), the amount of sediment that came out of the C-51, and the amount of material that deposited in the dredge hole (i.e., the muck). After construction, the contractor had to knock down the muck wave along most of the project; however, no measures were taken in areas of the project where the muck wave was small, as features of the wave still exists to the present.

Covering muck, and not displacing muck in the form of a wave, will be a priority during the D&I phase and will depend upon the bathymetric data and additional sediment data collected to find out where the thickest layers of muck currently reside. Preliminary data show approximately two (2) to four (4) feet of muck exist within the Bonefish Cove project site, which is significantly less than the excess of ten (10) feet of muck at the Snook Islands project site. The contractor will use turbidity control measures to comply with State and Federal permits.

5.3.1 Sediment Probes

USACE (2014) and PBC (2016) collected sediment probe data within the preliminary projects sites to a reconnaissance level design. Contractors used a telescoping fiberglass leveling rod to push into the bottom until refusal. The difference between the Echo sounders depth and the depth of penetration of the rod resulted in the muck thickness values.

In order to better characterize the material within the selected project site, and determine the variation in the thickness of muck sediments, additional data will need to be collected during the D&I phase. A better understanding of the subaqueous sediments (i.e., muck thickness) will allow for better site management and prevention of a muck wave and turbidity issues during construction. More than likely, the sediment probes will be collected in tandem with a multibeam survey.

5.3.2 Construction Techniques

During D&I, engineers will review the various sand capping techniques to reduce the likelihood of muck displacement. After review, an industry day will be held with potential bidders and consultants to better determine which performance measures should be specified to measure successful completion of entrapment of muck.

5.4 Materials

Materials needed for island creation are sediment to cap and raise the area to be constructed, riprap to shield the living shorelines from incipient wind and waves and stabilize the islands, and lastly, elevated structures (reef balls), which are used for organism recruitment.

5.4.1 Available Sediment

Sediment to be utilized for the project will be excavated from the Peanut Island DMMA where PBC DERM estimated the quantity available is near 400 kcy. Peanut Island was the sand source used for the creation of the Snook Islands and Grassy Flats, and successfully received state and federal permits for use in both 2005 and 2015. CESAJ has verified other sources of material that are readily available. However, Real Estate is needed to double handle the upland material from the mainland to the Bonefish location. The Port Authority is at capacity and does not have room for such an operation. Furthermore, there are no open spaces with enough bottom clearance for a 6' draft vessel without needing to buy property and then dredge an access channel to get the material. Currently, upland sand mine costs in general have been estimated to be \$40/ CY with this effort that cost go as high as \$150/cy, thus not being a cost effective approach. **Figure 5-2** shows the primary source and secondary source of material within Peanut Island.

During D&I, topographic surveys of Peanut Island will be collected at the primary source as well as the secondary source of material. Engineers, biologists, and geologists will conduct a site visit of the DMMA site to assess the condition as well as the appropriate quality and quantity of sediment within this facility to ensure compliance with state water quality standards.



Figure 5-2 – Excavation Areas and Transportation Routes within Peanut Island.

5.4.2 Protective Riprap

Riprap sizing will be determined by geotechnical and coastal engineers during D&I. For the estimate, it was assumed that 2-3' boulders mined from a local quarry would be used since it was the same material for the creation of the Snook Island and Grassy Flats projects. The current plan only has riprap on the western shoreline to protect the mangrove from constant boat wakes. Engineers will look into the sizing and area needed for rip-rap protection and will base their work on the following subheadings below.

5.4.2.1 Wind Analysis

The design life of the alternative considered is 50 years, which corresponds to a chance of occurrence of storm waves in any year of 2 percent. For the LWL area, this corresponds to a

design wind speed similar to a Category 2 Hurricane with wind speeds of 96 to 110 mph (83 to 96 knots) (NIST 2012).

5.4.2.2 Waves Analysis

LWL is effected by extreme events such as tropical storms and hurricanes between June and November. The design life of the alternative considered is 50 years which corresponds to chance of occurrence of storm waves in any year of 2 percent. A water level elevation of 4.8 ft for hurricane surge with 2 percent annual chance frequency was determined for LWL (FEMA). The wave heights and peak wave periods for design wind conditions are shown in **Table 5-1**. Generally, wave heights for design wind conditions range from 2 to 6 ft, and peak periods range from 2 to 4 seconds.

Table 5.1 - Alternative Site Shallow Water Wave Growth- Design Condition

Alternative Site	Fetch		Depth + Surge (ft)	Wave Height (ft)	Peak Wave Period (sec)
	Dir	Length (miles)			
Bonefish Cove	NNW	2.5	15.5	5.8	3.8
	NW	0.45	11	2.9	2.2
	SSW	1.5	13.5	4.8	3.2
	SW	0.5	11	3.1	2.3

(Wind speed = 96 knots , Duration = 12 hours)

5.4.3 Oyster Structures

Pre-fabricated artificial reef modules will be utilized for oyster reef creation areas, as described in the alternatives and Cost Appendix. Approximately 56 large pre-fabricated reef modules will be obtained for the project to create habitat for both oysters and juveniles fish.

5.5 Construction Constraints

At the cost risk register meeting, the sponsor highlighted some construction constraints that the awarded contractor is likely to encounter while performing work on this project. The

specifications will highlight these assumed project constraints for the Contractor. It is the responsibility of the Contractor to manage these constraints during the course of the contract; it is the responsibility of the Government to inform the Contractor of these risks early in the bidding process. There are exceptions to this and they are noted in each of the construction constraints discussed below.

5.5.1 Peanut Island Access

For the Snook Islands and Grassy Flats projects, barge access to the offloading area needed to be dredged prior to work. These were small quantities and placement occurred on the Port's DMMA. Bathymetric surveys of the DMMA will be attained during D&I to assess actual quantity to be removed. Please note Government specifications are performance based; since the Government does not know what kind of barges or the draft of those barges which will be brought. This additional line item could be paid as Lump Sum as a part of the DMMA preparation effort or as a contract line item as a unit price.

5.5.2 Bridge Restrictions

There are three (3) height restricted bridges within the 11.2 mile transport distance from Peanut Island to the placement site: Flagler Memorial Bridge, Royal Park Bridge, and Southern Boulevard Bridge. The bridge opening schedules are at set times within an hour to help facilitate marine traffic. The Flagler Memorial bridge opens once an hour at 15 minutes past the hour. Royal Park Bridge opens twice per hour at the on the hour and half past the hour. Lastly, the Southern Boulevard Bridge also opens twice per hour at 15 minutes and 45 minutes past the hour.

5.5.3 Operational Hours and Lighting Restrictions

The Town of Palm Beach will likely impose operational hours and lighting restrictions to the awarded Contractor. This has occurred on two recent USACE Corps projects: 2014 FCCE Palm Beach Erosion Control Project and 2014 and 2015 Jupiter Carlin Shore Protection Project. The Port of Palm Beach and the PBC have also experienced these operational hour restrictions when working adjacent to the Town's riparian rights. The operational hour restrictions are dependent on how close the project work is to Town residents. For the USACE contracts, contract language was inserted into the specifications that listed the Town of Palm Beach as the contact for operational hours and lighting restrictions within the Town limits. This worked flawlessly for both contracts where the Contractor was able to work 24 hours but with limited lighting. However, most of that work was just south of the port of Palm Beach and not work within the

lagoon where many of the Town's residents reside. Likely restrictions could be between 7am to 10 pm with limited lighting at the placement site.

5.5.4 Shallow Water Areas

Within the project area, the contractor may have to light load their scows to the project site to avoid shallow water. Surveys of the IWW occur annually and will be provided to the Contractor during bidding.

5.6 Post Construction

After construction, there will environmental and physical monitoring to measure the success or failure of the project and physical monitoring to monitor for settlement and effects of SLR. The recommended plan will not cause any physical adverse environmental effects. Sandy Flats and Snook Island constructed projects have not altered physical processes within the lagoon such as tides, or the circulation from the two inlets since their construction. Thus, the creation of island(s) in the lagoon should have no adverse environmental impacts to the physical processes within the lagoon, specifically sediment transport or hydrodynamics within the lagoon. Furthermore, the creation of these islands should reduce local erosion and should promote sediment accumulation, trapping the silty sediments degrading the water quality in the lagoon. This conclusion is based on the successful performance of the Snook Islands, and other eco-restoration projects within the lagoon.

5.6.1 Sea Level Rise Scenarios

As presented in Section 2.3.4.2, the high USACE sea level trend curve projects a sea level increase of 2.32 ft. The mean tide range in the Lake Worth Lagoon varies between 2.5 ft and 2.7 ft. Since the purpose of the project is to create habitat to increase ecosystem function in the Lake Worth Lagoon by creating additional inter-tidal and submerged habitats, the effects of rising sea level due to SLC are to potentially reduce the submerged habitat area caused by deeper depths than required by seagrasses for example or reduce inter-tidal area as the aerial extent of the island is reduced due to rising sea level.

While sea level rise can reduce the acreage of habitat created by this project, the uncertainty in sea level rise rates will only impact the relatively small habitat acreage of the project. There are no risks to life safety, property, or critical infrastructure due to the project in the event of higher

than expected sea level rise rates.

The primary strategy for project adaptation to maintain some level of functioning habitat is to add fill to the island's submerged and inter-tidal areas at a rate similar to the rate of sea level rise.

5.6.1.1 Qualitative Analysis of impacted Resources

A qualitative inventory of the density of impacted resources and receptors was conducted for the study area described in the feasibility study report. This study area is located within the horizontal and vertical extents bounded by the 100-yr high rate curve of SLC impacts. The 100-yr high rate curve SLC of 6.5 ft, impacts about 8,000 acres adjacent to the Lake Worth Lagoon,

based on 2006 and 2009 Florida Department of Emergency Management coastal LiDAR data. The qualitative inventory is presented in Table 5.2.

Table 5.2: Qualitative inventory of critical resources in the Lake Worth Lagoon study area.

Critical Resources in Study Area	Density of Resource	Relevant Notes	Risk from Sea Level Rise*
Residential structures	3	Several medium to high density areas throughout the lagoon and some portions of evacuation routes	3
Commercial structures	3	Numerous commercial facilities affected (marinas, businesses).	2
Environment and habitat	2	Saltwater marshes, mangrove and sea grass beds are located throughout the lagoon within the project area. Potential habitat areas for several endangered or protected species are within the project area.	3
Ports and navigation structures	2	Ports with cargo shipments that vary from commercial commodities to industrial goods and wastes are within the project area. The majority are located on the east shore of Lake Worth Lagoon adjacent to the inlet. USACE jetty structures are located at the channel mouth of Lake Worth Inlet.	1
Infrastructure (roads, water/sewer lines, boardwalks, railroads, airports)	3	Storm water control structures associated with canals (C-17, C-16 & C-51) face potential risk. Several roadways, including county roads and State Highways 703, 704, and A1A, are located within the project area. Majority of boardwalks and/or piers found in the bay area are at risk of inundation.	3
Critical facilities (police, fire, schools, hospitals, nursing homes)	1	At least six school parcels, several fire and police facilities and two health facilities located in a potential (low-lying) area.	3
Evacuation routes	1	Inundation occurs along a 3.5 miles section of Sate Highway A1A, 703 on Singer Island and portions of A1A, South Ocean Blvd in Palm Beach Island. Local roadways located in low-lying residential areas.	2
Recreation	3	Large areas of beach recreation. Three golf courses. Fishing piers, both private and commercial.	3

*3=high, 2=medium, 1=low

Sea level rise estimates provided earlier are added to the MHW line and graphically depicted onto the Alternative 1B cross-section (**Figure 5-3**). The baseline and up to the Intermediate SLR scenario will likely not impact the conceptual plan or inhibit future recruitment of seagrass or oysters. The mangrove islands will be fully established and be able to sustain wave over-

topping. However, the High SLR case will overtop the proposed rip-rap and likely would have seagrass die-off due to lack of sunlight. In all likelihood, the locals will need additional material to be placed on top of the existing substrate to sustain the established benthic habitat.

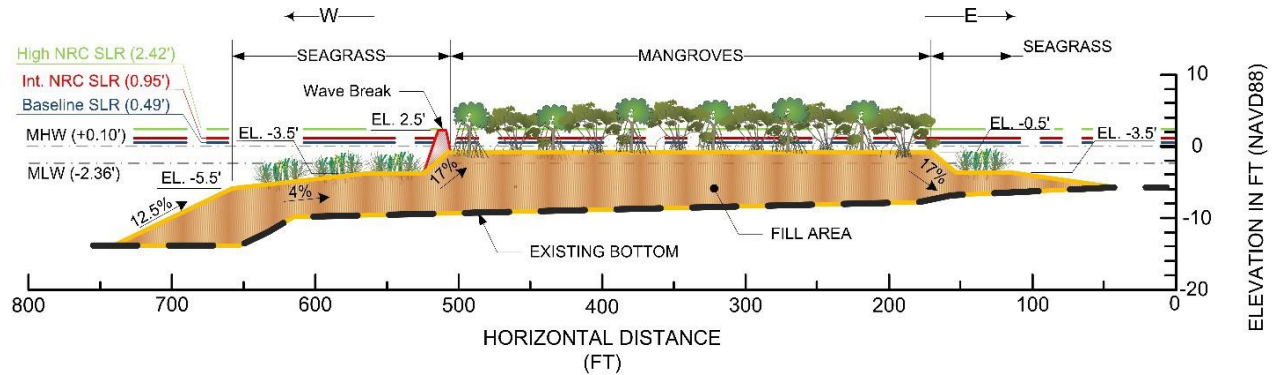


Figure 5-3 – Bonefish Conceptual Plan with Sea Level Rise Scenarios

5.6.2 Adaptive Management Plan

The Adaptive Management plan for the project will involve seagrass transect sampling, mangrove monitoring, and oyster monitoring.

5.6.3 Climate Change Analysis

The Climate Change analysis conducted per USACE requirements is included as Attachment G to this appendix.

ATTACHMENT A

REFERENCES

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The main purposes of this study was to explore the implications of human impacts on Little Lake Worth (LLW) and the surrounding environment, and to correlate the physiological characteristics of the primary producers to the physiochemical conditions of the lake. This report concludes that stratification within LLW has occurred and details on the sampling procedures, pigment analysis, and results that lead to the conclusion are provided.

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- [A-3] Clayton E. Hutcheson Agricultural Center Workshop, “Lake Worth Lagoon Living Shorelines Workshop Portfolio 1,” *Workshop offered by the Lake Worth Lagoon Initiative’s Habitat Working Group*, 2010.

This workshop offered shoreline protection alternatives to municipalities and waterfront landowners that will enhance the resources and water quality of the Lagoon. Portfolio 1 offers a detailed overview of the Workshop along with information defining Living Shorelines and the Lake Worth Lagoon Initiative.

- [A-4] Clayton E. Hutcheson Agricultural Center Workshop, “Lake Worth Lagoon Living Shorelines Workshop Portfolio 2,” *Workshop offered by the Lake Worth Lagoon Initiative’s Habitat Working Group*, 2010.

This workshop offered shoreline protection alternatives to municipalities and waterfront landowners that will enhance the resources and water quality of the Lagoon. Portfolio 2 offers case studies that highlight various methods employing plants and other natural materials to stabilize shorelines and maintain the natural coastline.

- [A-5] Clayton E. Hutcheson Agricultural Center Workshop, “Lake Worth Lagoon Living Shorelines Workshop Portfolio 3,” *Workshop offered by the Lake Worth Lagoon Initiative’s Habitat Working Group*, 2010.

This workshop offered shoreline protection alternatives to municipalities and waterfront landowners that will enhance the resources and water quality of the Lagoon. Portfolio 3 includes detailed information regarding CanVis visualization software and permits involving Living Shorelines along with a supplementary Case Study.

- [A-6] Clayton E. Hutcheson Agricultural Center Workshop, “Lake Worth Lagoon Living Shorelines Workshop Portfolio 4,

” Workshop offered by the Lake Worth Lagoon Initiative’s Habitat Working Group, 2010. This workshop offered shoreline protection alternatives to municipalities and waterfront landowners that will enhance the resources and water quality of the Lagoon. Portfolio 4 includes a driving tour map, driving directions, as well as detailed information regarding Lake Worth Lagoon Grant programs, the Intracoastal Waterway, and the Florida Coastal Program.

- [A-7] Coastal Eco-Group, Inc., “Lake Worth Lagoon Fixed Transect Seagrass Monitoring Cumulative Report 2013,” *Report prepared for the Palm Beach County Department of Environmental Resources Management*, 2014.
- Monitoring Report on the trends of the nine permanent transects within Lake Worth Lagoon. This Report highlights the Seagrass variations during the 13 year monitoring period along with some of the key contributors to these variations.*
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- This map illustrates the density of seagrass habitats in the north, central, and south segments. The seagrass surveys occurred during the July 2013 thru January 2014 interval while the July 2013 aerial that serves as a template was provided by Palm Beach County Department of Environmental Resource Management.*
- [A-9] Coastal and Oceanographic Engineering Department University of Florida, “Fine Sediment Regime of Lake Okeechobee Part 1,” 1989.
- This report summarizes field and laboratory studies implemented to characterize the sediments of Lake Okeechobee. Part 1 of the report is comprised of the main report along with the bulk of the appendices.*
- [A-10] Coastal and Oceanographic Engineering Department University of Florida, “Fine Sediment Regime of Lake Okeechobee Part 2,” 1989.
- This report summarizes field and laboratory studies implemented to characterize the sediments of Lake Okeechobee. Part 2 of the report consists of the remaining portion of the appendices.*
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- Florida Inland Navigation District permit for dredging within the Intracoastal Waterway adjacent to Peanut Island. Permit allows mechanical or hydraulic means to dredge approximately 95,580 cubic yards of material to be placed within the Peanut Island Dredged Material Management Area (DMMA).*
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- This report provides key dredging construction observations established during the site visit of Lake Worth Lagoon for Deepening within the Intracoastal Waterway.*
- [A-13] Dunkelberger Engineering & Testing, A Terracon Company, “Geotechnical Engineering Report Standard Penetration Test Borings Intracoastal Waterway Deepening Project Palm Beach County, Florida,” *Report prepared for the Florida Inland Navigation District*, 2015.
- This report provides a summary of the project considerations, methods utilized for subsurface exploration, and key findings from the sediment sampling within Lake Worth Lagoon for deepening within the Intracoastal Waterway immediately West of Peanut Island.*

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Pre-survey of Peanut Island DMMA including volumes and cross sections.

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Sea Turtle research within Lake Worth Lagoon highlighting the abundance and distribution of species found along with disease present.

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This drawing clearly displays the maintained canal elevations within the Lake Worth drainage district.
- [A-22] Lake Worth Drainage District, “Lake Worth Drainage District location map,” 2011.
This drawing identifies the Lake Worth Drainage District.
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- [A-26] Palm Beach County Comprehensive Plan Map Series, “Drainage District Boundaries,” 1999.
This drawing provides a glimpse of the South Florida Water Management District along with boundaries for the individual Water Management Districts.
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This document lists the basic features of Lake Worth Lagoon along with a snapshot of some of Lake Worth Lagoon’s key Estuarine Resources.
- [A-28] Palm Beach County Environmental Resource Management, “Artificial Reefs of Lake Worth Lagoon,” 2011.
This map presents an aerial perspective of Lake Worth Lagoon and indicates all artificial reef sites stationed within.
- [A-29] Palm Beach County Environmental Resource Management, “Lake Worth Lagoon Completed Projects 2008-2013,” 2011.
This map presents an aerial perspective of Lake Worth Lagoon and indicates locations for projects completed within the 2008-2013 period.
- [A-30] Palm Beach County Board of County Commissioners Department of Environmental Resources Management, “The Lake Worth Lagoon Initiative Funding Program,” 2015.
Provides program overview along with impressions of the main restoration efforts.

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This Brochure provides material to promote awareness, current challenges that the Lagoon is combating, residents of the lagoon, provides a brief timeline of the lagoon, and offers details on select areas of the Lagoon.

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This report provides information on the Lake Worth Lagoon Initiative, the Funding Program, and focuses on the fiscal year 2015 request to fund projects that would improve the lagoon’s habitat and water quality. Also, details on funding and prior projects since 1998 were presented along with monitoring efforts.

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This revision to the management plan provides a comprehensive view of the Lagoon’s current status, fundamental goals for restoration, and the most prominent change to the initial plan is the incorporation of specific action plans established for the subsequent 5 years. Other topics visited include public outreach, interagency collaboration, and funding.

- [A-34] Palm Beach County Department of Environmental Resources Management, “Lake Worth Lagoon Management Plan Revision Appendix A,” 2008.

This section of the management plan consists of water and sediment quality data. The data provided is in the form of notched box and whisker plots where the above mentioned were used to test for significance between data sets to determine if trends exists.

- [A-35] Palm Beach County Department of Environmental Resources Management, “Lake Worth Lagoon Management Plan Revision Appendix B,” 2008.

This section of the management plan provides summaries of prior restoration projects, artificial reef projects, stormwater improvement projects, and sediment management projects. Also, a supplementary aerial map is provided to indicate positions for other coastal restoration projects.

- [A-36] Palm Beach County Department of Environmental Resources Management, “Lake Worth Lagoon Management Plan Revision Appendix C,” 2008.

This section of the management plan delivers details regarding proposed projects. Details are in regard to habitat enhancement and restoration project prioritization, studies and monitoring, and water and sediment quality.

- [A-37] Palm Beach County Environmental Resources Management, “Lake Worth Lagoon Oyster Monitoring,” n.d.

This map provides locations of oyster habitats along with points of monitoring.

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This map provides an aerial perspective of Lake Worth Lagoon while displaying essential seagrass monitoring stations, water quality stations, and provides discrete values for 2007 seagrass conditions.

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This map provides an aerial perspective of Lake Worth Lagoon while displaying essential components of the lagoon including vegetation and structural features.

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This map provides an aerial perspective of Lake Worth Lagoon while displaying watershed boundaries in conjunction with water management district structures and hydrography.

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Brochure that offers paddling tips, paddling resources, three detailed paddling adventures, and a map that indicates points of interest along with kayak launch areas.

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This map provides an aerial perspective of Lake Worth Lagoon while displaying onsite sewage treatment and disposal systems along with septic boundaries.

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Drawing that identifies the boundaries of the Wellington Drainage District.

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This drawing provides an aerial perspective of Pine Tree District, Acme District, and Lake Worth District boundaries.
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This drawing provides an aerial perspective of detailed hydrology within the Wellington District.
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ATTACHMENT B

LAKE WORTH LAGOON - WATERSHED

B1.0 Lake Worth Lagoon Watershed Characterization

The LWL watershed (**Figure B-1**) has one of the most urbanized areas of the state with a managed canal system. The primary drainage canals are managed by the State of Florida with secondary and tertiary canal systems managed by local drainage districts and multiple public municipalities. There are seven drainage basins comprising the LWL watershed: L-8, STA-1E, C-17, C-51, C-16, and Lake Worth Lagoon basin with a total of 478.45 square miles (**Table B-1**). There are three major canals (C-17, C-51, and C-16) that discharge freshwater into the LWL. The C-17 canal (Earman River) discharges into the north segment of the LWL, C-51 canal (West Palm Beach Canal) discharges into the central segment of the LWL, and C-16 canal (Boynton Canal) discharges into the south segment of the LWL. These three canals are the primary outlets for the LWL watershed’s storm water runoff and also the primary sources of freshwater into the lagoon. Each canal (C-17, C-51, and C-16) has a managed spillway structure at its downstream end that discharges directly into LWL: S-44, S-155, and S-41, respectively.

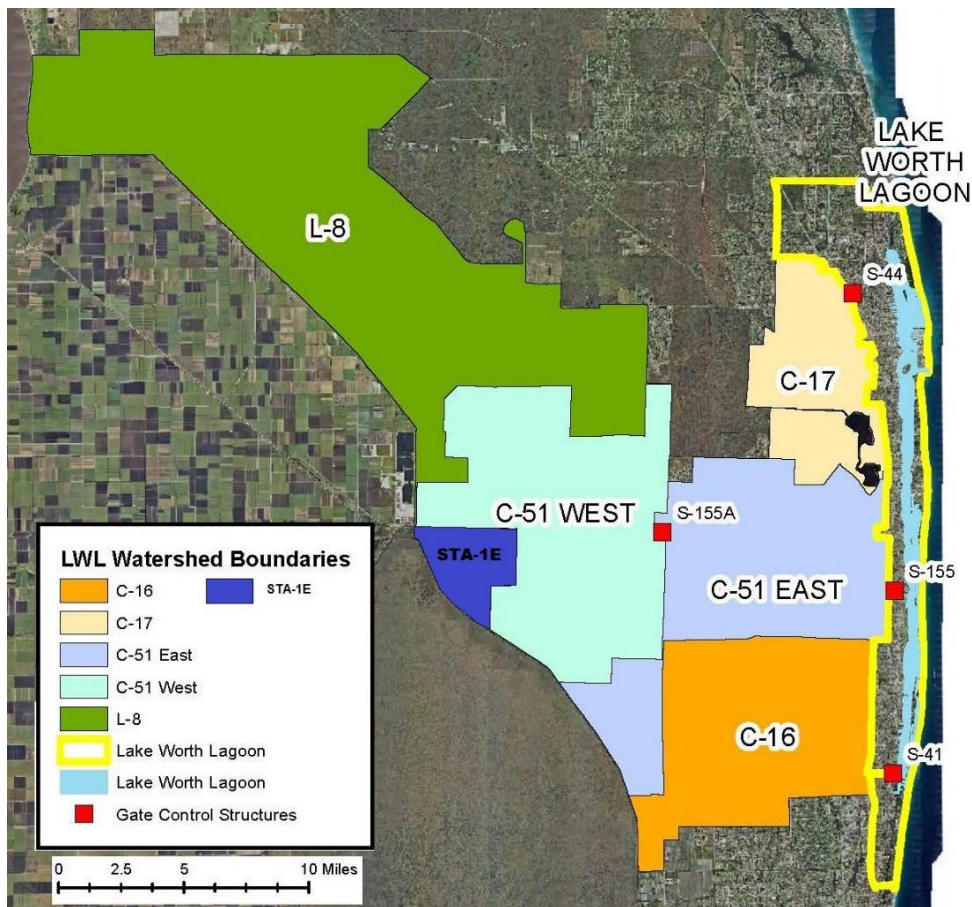


Figure B-1 – Lake Worth Lagoon Watershed

Table B-1 – Lake Worth Lagoon Watershed Basin

Basin	Area (sq. mi.)
L-8	157.19
STA-1E	10.23
C-51 West	80.84
C-17	34.93
C-51 East	73.46
C-16	62.21
Lake Worth Lagoon	59.59
Total	478.45

B1.1 L-8 Basin

The L-8 basin is the largest basin in the LWL watershed being 157.19 sq. mi. located in the northwestern corner of the LWL watershed (**Figure B-1**). The L-8 basin is mostly undeveloped, dominated by the J. W. Corbett National Wildlife Refuge and Management Area (JWCWMA) containing cypress groves, ponds, sloughs, freshwater marsh, wet prairie, upland forest, and pine flatwoods. The L-8 Canal, which drains the L-8 basin, begins at the southeastern edge of Lake Okeechobee and extends southeastward to its terminus at the intersection of C-51 canal. In addition to draining the L-8 basin, the L-8 canal also receives stormwater from Lake Okeechobee and runoff from the agriculture areas, Everglades Agricultural Area (EAA), immediately adjacent to and southwest of the L-8 canal.

B1.2 STA-1E Basin

The STA-1E basin (**Figure B-1**) is a storm water treatment impoundment constructed for water quality purposes. The STA-1E is located at the western edge of the LWL watershed and is 10.23 sq. mi. in area. It is bounded in the north by C-51, where the STA-1E pumps its water from via pump station S-319, and discharges to the south into Water Conservation Area 1 (WCA1).

B1.3 C-17 Basin

The C-17 basin is 34.93 sq. mi. in northeastern Palm Beach County. Its primary purpose is to drain the developed urban and residential incorporated areas of West Palm Beach, Palm Beach Gardens, Riviera Beach, Lake Park, Cloud Lake, Glen Ridge, and Mangonia Park (**Figure B-2**). There are two local drainage districts that manage the C-17 basin’s canals: Northern Palm Beach County Improvement District and the Lake Worth Drainage District. The C-17 canal is operated and maintained by the

SFWMD. The C-17 outlet into the LWL is regulated by the S-44 structure, a 2,070 cfs reinforced concrete, spillway structure designed to pass 60% of the SPF.

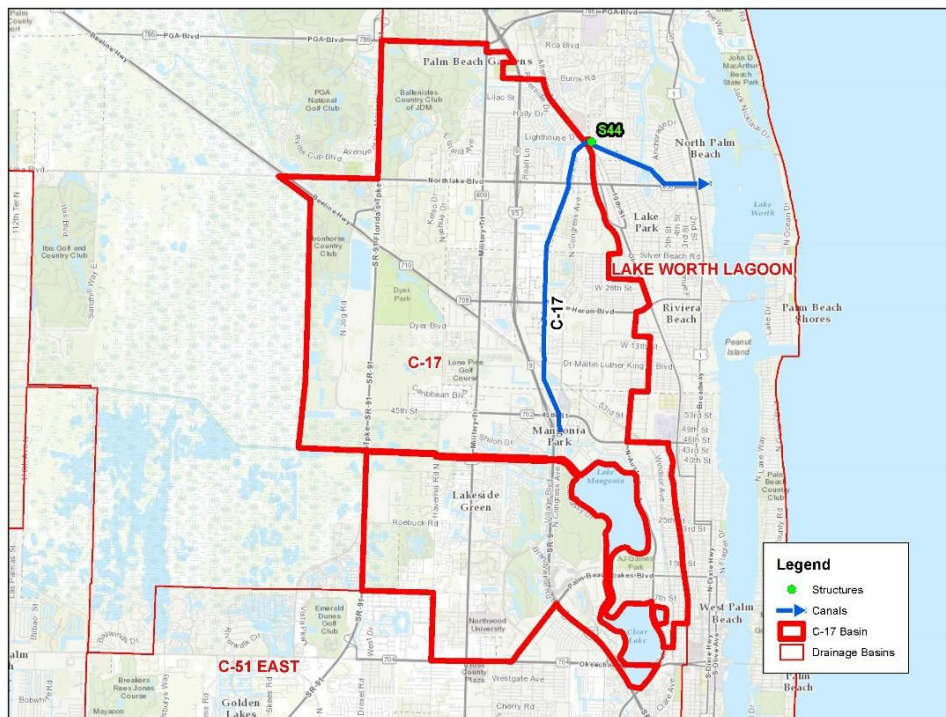


Figure B-2 - C-17 Basin

B1.4 C-51 West Basin

The C-51 West basin is 80.84 sq. mi., which is the second largest basin in the LWL watershed. Its primary purpose is to drain the incorporated area of Royal Palm Beach (**Figure B-3**). There are five local water drainage districts managing the secondary canals in the C-51 West basin: Acme Improvement District, Pine Tree Water Control District, Indian Trail Improvement District, Seminole Water Control District, and the Northern Palm Beach County Improvement District. Urban and residential land uses are the dominant land use in the basin.

The C-51 canal is the main water surface canal for the C-51 West Basin (and for all of Palm Beach County) with the canal providing flood protection for both C-51 East and West basins, excess flows from L-8 canal and Lake Okeechobee (when needed), as well as providing relief for EAA runoff. The canal also helps maintain groundwater levels for water supply and prevents saltwater intrusion. The western terminus of the C-51 canal is bounded east by the 700 cfs S-5AE culvert structure and in the east by the 4,800 cfs S-155 gated spillway structure. In between, approximately 11.2 miles upstream from S-155 is the 1,460 cfs S-155A gated spillway structure, which demarcates the separation of C-51 West basin from

C-51 East basin. The S-155A structure provides additional operational capability for managing canal levels.

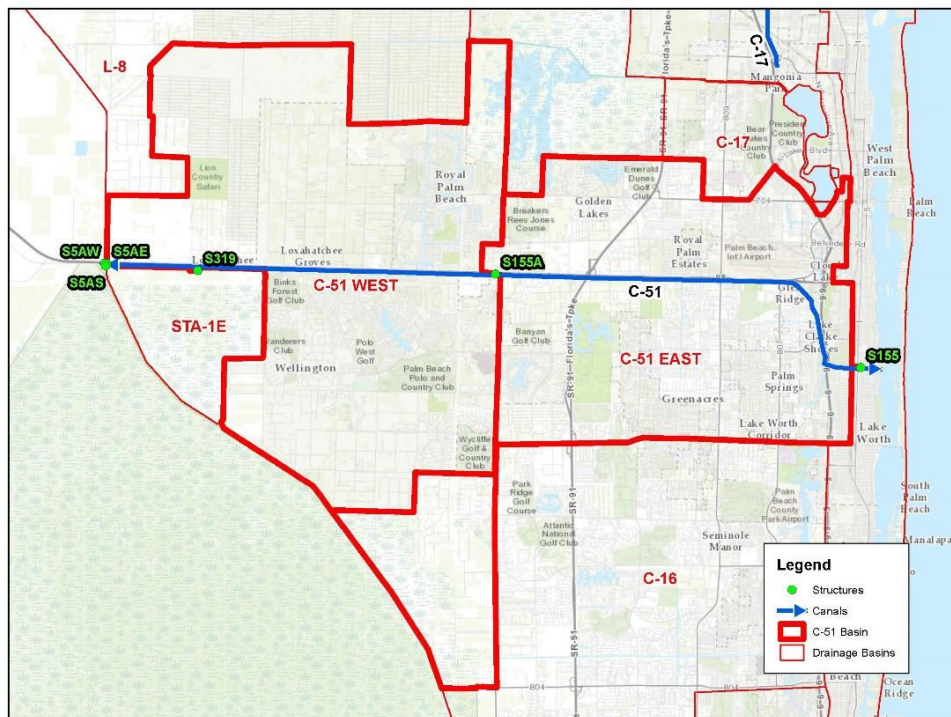


Figure B-3 – STA-1E and C-51 West and East Basins

B1.5 C-51 East Basin

The C-51 East basin is 73.46 sq. mi. and is also the most developed basin within the LWL watershed. Its primary purpose is to provide drainage for the incorporated areas of West Palm Beach, Lake Worth, Greenacres City, Palm Springs, Lake Clarke Shores, and Haverhill (Figure 2-3). There are two water control districts in the C-51 East basin: North Palm Beach County Improvement District and Lake Worth Improvement district. The eastern terminus of the C-51 canal is the S-155 gated spillway structure which is the primary discharge of freshwater into LWL.

B1.6 C-16 Basin

The C-16 basin is 62.21 sq. mi. in east central Palm Beach County (**Figure B-4**). Its primary purpose is to provide drainage for the developed incorporated areas of Atlantis, Boynton Beach, Lantana, Greenacres City, and Lake Worth. The primary local water control district for the basin is Lake Worth Drainage District. The C-16 canal is operated and maintained by the SFWMD. The C-16 canal's eastern terminus is the 4,500 cfs S-41 gated spillway structure that discharges into the LWL.

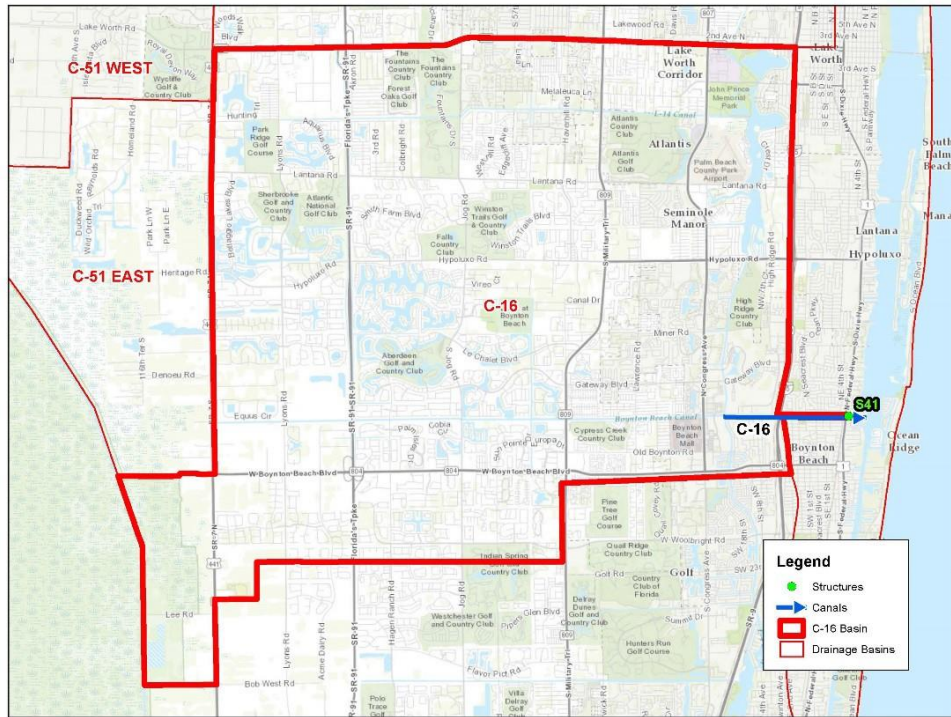


Figure B-4 – C-16 Basin

B1.7 Lake Worth Lagoon Basin

The Lake Worth Lagoon Basin is about 59.6 sq. mi. that stretches much of the length of the LWL itself. This basin is located east of all the major water control structures and is the recipient of all the flows from the watershed. The C-17 canal discharges in the upper northern segment, C-51 canal to the central segment, and C-16 to the lower southern segment of the lagoon. The LWL basin is the fourth most developed basin in the watershed and includes the incorporated areas of Jupiter, Palm Beach Gardens, North Palm Beach, Riviera Beach, West Palm Beach, Lake Worth, and Boynton Beach. The LWL basin’s land use is predominantly urban, high and medium density residential land uses.

B1.8 Land Use

Land use was acquired from the United States Geological Survey (USGS) National Land Cover Database 2011 Land Cover (NLCD 2011). Land use in the LWL watershed is generally characterized by medium-to-high density, developed urban & residential areas in the east and along the coast and low density residential and agricultural areas farther to the west (**Figure B-5**).

The total percentage of area for developed and undeveloped land of the LWL watershed according to the NLCD 2011 data is 55.70% and 40.75%, respectively (**Table B-2**).

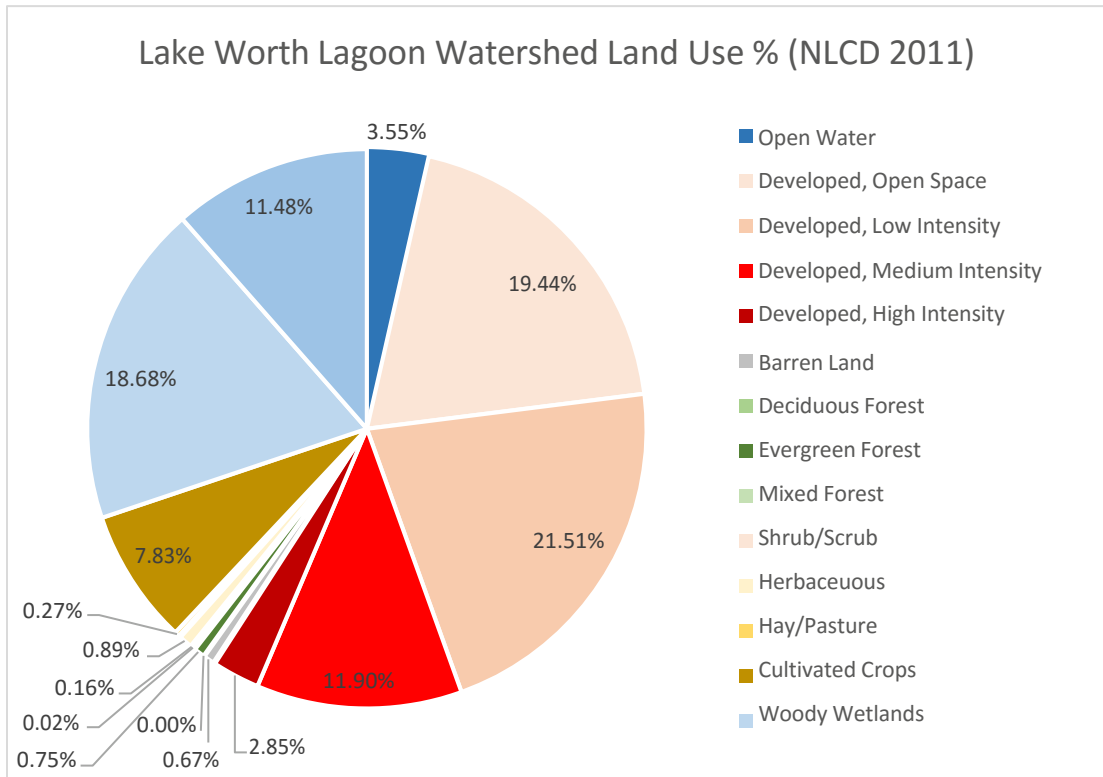


FIGURE B-5 Lake Worth Lagoon Watershed Land Use Allocation (NLCD 2011)

TABLE B-2 Developed vs. Undeveloped Area Allocation in the LWL Watershed

Category	Land Cover Class	Percentage	Total
Water	Open Water	3.55%	3.55%
Developed	Developed, Open Space	19.44%	55.70%
	Developed, Low Intensity	21.51%	
	Developed, Medium Intensity	11.90%	
	Developed, High Intensity	2.85%	
Undeveloped	Barren Land	0.67%	40.75%
	Deciduous Forest	0.00%	
	Evergreen Forest	0.75%	
	Mixed Forest	0.02%	
	Shrub/Scrub	0.16%	
	Herbaceous	0.89%	
	Hay/Pasture	0.27%	
	Cultivated Crops	7.83%	
	Woody Wetlands	18.68%	
	Emergent Herbaceous Wetlands	11.48%	

ATTACHMENT C

LAKE WORTH LAGOON PAST PROJECTS

C1.0 Ecosystem Enhancement Projects within Lake Worth Lagoon

Human activities over the past 100 years have degraded the Lagoon's habitat and water quality. Examples include the construction of permanent inlets, dredging and filling of wetlands along the shoreline, channel dredging, wastewater discharges, and the construction of seawalls, canals, bridges, causeways, docks, marinas, the port, and power plant. Today, 81% of the shoreline is bulkheaded, only 283 acres of mangroves remain, and much of the stormwater from the urbanized watershed is not treated to remove pollutants before discharging to the Lagoon.

While the lagoon faces many challenges, significant natural resources remain that are worth preserving and enhancing. The lagoon's economic, environmental and recreational value is connected to these resources, which include seagrass beds, underwater reefs, recreationally and commercially important fish species, and imperiled species such as manatees and sea turtles. Since 1987, multiple partners have implemented efforts to benefit the Lagoon. Projects include creation and enhancement of valuable habitat, implementation of stormwater retrofits to improve water quality, and updates to the Lake Worth Lagoon Management Plan.

Despite the success of the past few decades, challenges remain. Urban and agricultural runoff containing contaminants, toxins, nutrients, and sediments, increasing residential and commercial growth, and a lack of understanding among residents and visitors regarding how individual behaviors affect the LWL, continue to stress this valuable urban estuary.

C2.0 Ecorestoration Projects within Lake Worth Lagoon

Significant work has been accomplished over the past few decades to protect, restore and enhance Lake Worth Lagoon, Palm Beach County's largest estuary. Since the late 80s, multiple partners have implemented efforts to benefit the lagoon. These projects are summarized in the **Figure C- 1** and **Table C- 1** below.

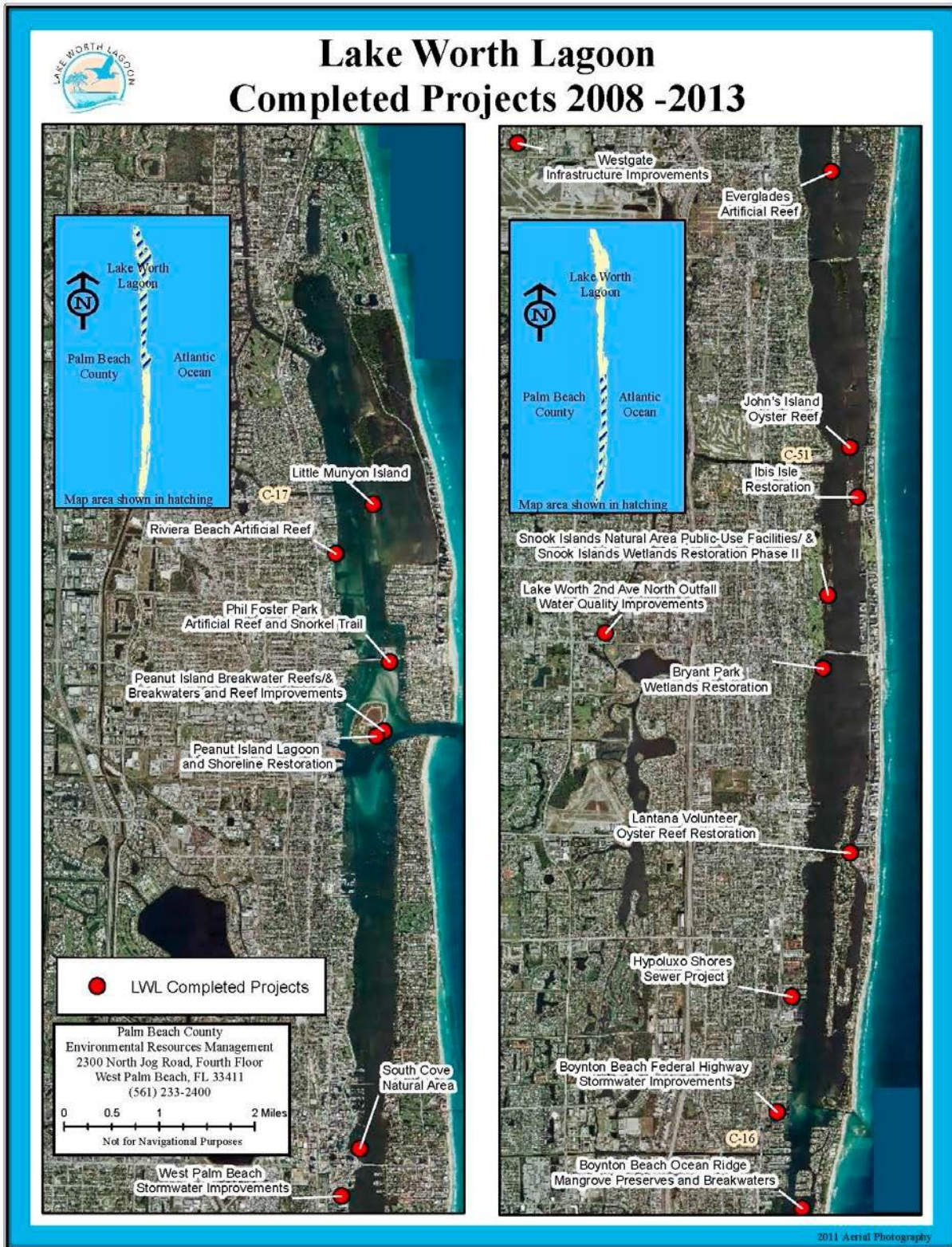


Figure C- 1. Locations of ecorestoration projects within Lake Worth Lagoon.

Table C- 1. Summary of ecorestoration projects within Lake Worth Lagoon.

Name	Year Completed	Summary (what and why)	Sponsor
Peanut Island Breakwater Reefs, Lagoon and Shoreline Restoration	2005	Restored 26 acres of upland habitats: dune, coastal strand, and maritime hammock. Removed 60 acres of exotic plant species like Australian pine and Brazilian Pepper. Constructed 5 acres of wetland habitats: a snorkeling reef system and shallow-water lagoon habitat with tidal channels to flush existing mangroves. Native dune plantings on the 12-foot high levee surrounding the Florida Inland Navigation District’s 23-acre dredged material management area provides slope stabilization and quality wildlife habitat. Installed over 125,000 native plants. Placed 36,000 tons of limestone and granite boulders for habitat and shoreline stabilization.	Palm Beach County, FIND, USACE, Port of Palm Beach, USDA and FWC
Snook Islands Natural Area, and Wetlands Restoration Phase II	2005	Restored 100 acres of wetland habitat in the Lake Worth Lagoon. Filled deep holes with 1.2 million cubic yards of sand from Peanut Island that had been previously dredged to maintain the Intracoastal Waterway and inlets. Eliminated erosion and created a natural shoreline along 1.2 linear miles of the lagoon. Removed nonnative plant species like Australian pine, Brazilian pepper and seaside mahoe from five acres of shoreline and restored 1.7 acres of existing mangrove fringe. Planted 11 acres of mangroves and 3.8 acres of salt marsh along the shoreline and on the islands.	Palm Beach County, USACE, FIND, City of Lake Worth

Section 1135 Lake Worth Lagoon - Ecosystem Restoration Project
 LWL Past Projects – EN Attachment C

Name	Year Completed	Summary (what and why)	Sponsor
West Palm Beach Canal (C-51) and Sediment Management	2008	Over 100,000 cubic yards of muck were hydraulically dredged from the C-51 Canal and transported through pipelines to settling ponds located adjacent to the West Palm Beach Golf Course. A 12-acre sediment trap was created in the canal to act as a “sump” to trap sediments before they are discharged to the lagoon.	Palm Beach County, SFWMD, City of West Palm Beach
Munyon Island	2009	Located just south of Munyon Island, this project includes a 1.4 acre privately-owned island, 7.5 acres of privately-owned submerged lands, and 10.3 acres of State-owned submerged lands. Construction was completed to offset resource impacts associated with the expansion of Rybovich Marina in West Palm Beach and included the removal of exotic vegetation, planting of native plants, and construction of a 1,525 ft long wave break wall to enhance seagrass growth.	Palm Beach County, FIND, West Palm Beach Fishing Club, USACE, Florida Dept of Agricultural and Consumer Services, State of Florida
Ocean Ridge Natural Area	2009	Limestone boulders were placed along the shoreline to serve as a wave break. To provide additional habitat, a mangrove planter was constructed behind the wave breaks. The project was designed to protect 35 acres of existing mangroves, including a mangrove fringe that has slowly eroded from boat wakes. Mangroves provide important habitat for many species of fish and wildlife and improve water quality. The rock also provides shallow water artificial reef habitat which is ideal for oysters and other attaching organisms.	City of Boynton Beach and the Town of Ocean Ridge
Ibis Isle Restoration	2010	Existing muck deposits were capped with clean sand along Ibis Isle, providing substrate and habitat improvements. The sand cap was placed and contoured to create 8.3 acres of mangrove, cordgrass and 0.8 acres of oyster habitat.	Palm Beach County, Town of Palm Beach, and the South Florida Water Management District
Lantana Mangrove Planter and Oyster Reef Restoration	2010	To increase oyster habitat and promote public awareness, more than 160 volunteers filled 1,400 netted bags with 24 tons of fossilized shell and placed them along the Lantana Nature Preserve shoreline. A follow-up project assembled 25 volunteers to place 250 oyster bags a along 60- feet of seawall at the Town of Lantana’s Bicentennial Park.	Palm Beach County, the Town of Lantana, and the West Palm Beach Fishing Club

Section 1135 Lake Worth Lagoon - Ecosystem Restoration Project
 LWL Past Projects – EN Attachment C

Name	Year Completed	Summary (what and why)	Sponsor
John's Island Oyster Reef	2012	Small limestone boulders were placed to create almost 10 acres of oyster reef habitat. The addition makes a significant contribution to intertidal habitat and water quality improvements. Boulders were placed in discrete piles with open spaces between each pile. The open space provides an edge between the sand and rock, allowing fish and invertebrates easy entry to the rock structures and water flow. Water flow is important to oyster health by delivering oxygen and food, and for settlement of oyster spat.	Palm Beach County, Town of Palm Beach, and Florida Inland Navigation District
South Cove Natural Area	2012	A deep dredge hole was filled and raised to elevations for recruitment of seagrass, and to create a series of mangrove islands. The project created mangrove (2 ac), seagrass (3.5 ac), and oyster habitat (1 ac). Fisheries and wildlife benefit from increased food supplies, nursery areas, and water quality improvements. Public-use components include an elevated boardwalk, observation deck, and an informational kiosk.	City of West Palm Beach and the Florida Inland Navigation District.
Grassy Flats Sand Capping	2015	51,000 cubic yards of sand were spread over 13 acres of the lagoon. The sand was used to cap muck sediments and construct two islands. Thousands of tons of limestone rock were placed around the man-made islands for protection and thousands of native wetland plants were planted.	Palm Beach County, FWC, USFWS
Bryant Park Wetlands Restoration	2015	Created 575 feet of living shoreline along a barren seawall. Constructed a 125-foot wetland planter using a prototype design created by a team of biologists, engineers and artists to retain soils for intertidal plants, promote oyster growth and offer passages for fish. Installed 450 feet of riprap rock to provide oyster reef habitat and protect the shoreline. Improved seawall protection by installing living shoreline which will attenuate waves and boat wakes.	Palm Beach County, FDEP, National Endowment for the Arts, City of Lake Worth

C2.1 Ecorestoration Projects of Interest in Lake Worth Lagoon

Projects with components similar to the feasibility study and recommended plan. Of additional note, Peanut Island is both the location of ecorestoration projects, and the proposed sand source for the recommended plan.

C2.1.1 Peanut Island

Peanut Island was originally constructed in beginning in 1918, from material dredged to create the Lake Worth Inlet and maintenance of the Intracoastal Waterway. Over time, the 79-acre island became overgrown with a forest of non-native (exotic) vegetation, primarily Australian pines.

Limestone rock (500 tons) was used to construct three breakwaters on Peanut Island's shoreline. One breakwater was constructed on the east side of the island and two smaller structures were installed on the southeastern shoreline. The structures not only slow beach erosion and provide shoreline protection, they also provide reef habitat. The breakwater reefs are very popular with snorkelers and provide a variety of restored habitats for fish, invertebrates, and birds.

Sand was dredged from the Peanut Island boat docks and fishing pier and reused onsite to stabilize the beach and prevent further erosion of the walking path. The sand was also used to re-contour the snorkeling lagoon and create 0.4 acres of intertidal *Spartina* (salt marsh cordgrass) habitat which stabilizes the shoreline, increases nutrient uptake, and provides important wildlife habitat.

The project was designed to improve the tidal flow within the snorkeling reef system and provide increased shoreline protection and reef habitat on the island's east shore. The existing rock infrastructure was modified by removing rocks that impeded tidal flow, and re-used them to build reef breakwaters along the adjacent beach. The reef system is extremely popular with snorkelers due to the clear oceanic water, fish, coral, and other reef resources that it provides.

C2.1.2 Grassy Flats

This project was designed to restore critical marine habitats so that fish, oysters and wildlife will return to an area known as Grassy Flats that was previously uninhabitable because of accumulated muck on the seafloor. This dynamic project involved many stages, one of which was spreading 51,000 cubic yards of sand over 13 acres of the lagoon using specialized equipment. The sand was used to cap muck sediments on the lagoon seafloor and construct two islands. Later stages of the project included placing thousands of tons of limestone rock around the man-made islands to protect them and planting thousands of native wetland plants.

C2.1.3 Snook Islands

The Snook Islands Natural Area, completed in 2005, restored 100 acres of wetland habitat in the Lake Worth Lagoon. The new facilities allow visitors to view wildlife, fish, and explore the lagoon waters. Public-use components includes a boardwalk with observation platform, fishing pier, kayak launch structure, day-use docks, boat trailer parking, bike racks, benches, and informational kiosks. Public use facility project partners include Florida Inland Navigation District, and the City of Lake Worth.

The Snook Islands Phase II project included the construction of two mangrove islands and oyster reefs. Fish and wildlife habitat created include 0.45 acre oyster reef, 0.74 acre red mangrove, and 7.17 acres of seagrass habitat. Overall, the project will improve habitat for birds using the open areas of shoreline and mudflats, fish, and other wildlife.

Project partners include the Florida Department of Transportation and the City of Lake Worth. This project completes the original Snook Islands Natural Area that was constructed in year 2005. All together, Snook Islands is a hot-spot for birders and anglers alike: species of wading and shorebirds are common, and the American oystercatcher has been known to breed and raise young there. Mullet, snook, and other fish species are also prevalent.

C3.0 Ecosystem enhancement projects

Artificial reefs within the LWL create new marine life communities and provide nursery habitat for many marine/estuarine species. Generally these reefs are placed in locations where little productive habitat exists such as dredge holes. Dredge holes within the Lagoon can be as deep as 35 ft. making these ideal locations for artificial reefs by increasing their habitat value. The reef structures are built from a variety of materials: limerock boulders, demolition concrete, old barges, and prefabricated modules. These reefs replace habitat that has been lost because of coastal development, and while being different compared to shallow water softbottom, mangrove and seagrass habitats also altered by development, reefs supply the physical structure that provide shelter and increase productivity of the Lagoon. Juvenile fish of reef species are always present in varying numbers which suggests the reefs may be serving as nurseries for offshore populations.

Thirteen artificial reef sites have been constructed to date; the majority of them deployed in the northern portion of the LWL, and are shown in **Figure C- 2**.



Artificial Reefs in the Lake Worth Lagoon

Map created 1/29/13

Figure C- 2. Artificial reefs created in Lake Worth Lagoon.

Kelsey Park Reef is a 2 acre site (10' deep) located 1.75 miles north of the Lake Worth Inlet on the west side of the Lagoon. This reef was constructed between 2004 -2008 and contains concrete materials from the demolition of the old Forest Hill High School, limestone boulders, and 18 concrete modules placed by the Riviera Beach Maritime Academy.

Sugar Sands Ledges is a 6 acre site located in a 26' deep dredged hole, 0.25 mile north of the Blue Heron Bridge and east of the ICW. Multiple deployments from 1991-99 include pyramid modules, limestone boulders & ledges, which provide habitat complexity and a diverse fish assemblage.

Rybovich Reef is a 2 acre site located 1.5 miles south of the Lake Worth Inlet and was constructed between 1991-2004. The reef consists of a variety of materials including concrete, pyramids, reefballs (deployed by RRT) concrete ledges, Jersey barriers, trommel screens, limerock boulders and a 60' barge, which provide an interesting and complex habitat in 29' water depth with maximum relief of 13' (**Figure 23a**).

Blue Heron Bridge (BHB) site is known as the “Muck Diving Capital of the US”. The area is a very unique underwater environment frequented by SCUBA divers from around the world, particularly underwater photographers. Because of Palm Beach County’s proximity to the Gulf Stream, this dive site has documented 686 species of marine mollusks.

Phil Foster Snorkel Reef is a 0.6 acre snorkel reef constructed south of the BHB in August 2012 and consists of limerock boulders and prefabricated modules placed in discreet reef pods at an 8' depth. A monitoring event conducted 1 month after installation documented 11 families and 26 species of fish, and 3 months later documented 26 families and 63 species of fish. Two species each of grunt and snapper were in schools of greater than 100 individuals. The reef is expected to become as diverse as BHB over time.

Peanut Island is located at the mouth of the Lake Worth Inlet and has 4 separate reef sites. The fishing pier and east dock sites contain concrete tetrahedrons, modules and caprock deployed in 2000 and 2011. Major enhancements occurred on the Island in 2005, including creation of the 10' deep snorkel reef which is protected by limestone and granite boulders. Between 2006 and 2012, 6 breakwaters were added on the east and south sides of the island. These multiple structures encompass 1.7 acres in depths ranging from 2'- 4'.

Currie Park Reef is a 0.01 acre site located 2.6 miles south of the Lake Worth Inlet. The reef consists of 100 tons of limerock boulders, deployed at 5' depth under the pier. Central LWL contains 2 artificial reefs located at Everglades and Snook Islands.

Everglades Island Reef is 0.1 acre site located 5.75 miles south of the Lake Worth Inlet. The 18' deep fishing reef was deployed in February 2011 and consists of an 87' barge and 1,100 tons of concrete ledges with 8' of relief.

Snook Islands Reef is a 0.05 acre site located 5 miles north of the South Lake Worth Inlet. The fishing reef was deployed in April 2011 and consists of 700 tons of concrete bridge material with an approximate 4' relief in 12' water depth.

Lantana Reef is a 0.5 acre site located 3 miles north of the South Lake Worth Inlet. The fishing reef was deployed in 2002-2003 and consists of 250 tons of concrete box culverts, 20 reef balls and 500 tons of limerock boulders at a 10' depth.

Boynton Inlet Reef is a 0.7 acre site located inside the South Lake Worth Inlet adjacent to Ocean Inlet Park. This reef was deployed in 1994 and consists of 900 tons of limerock boulders at a 10' depth. Additional rock (500 tons) was added in 2002.

ATTACHMENT D

PEANUT ISLAND PHASE I ESA

PHASE I ENVIRONMENTAL SITE ASSESSMENT

for

Peanut Island
Lake Worth Inlet



prepared by:
Palm Beach County
Environmental Resources Management
Environmental Review & Natural Areas Division

prepared for:
U.S. Army Corps of Engineers

November 1997



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1.0 SUMMARY

The Palm Beach County Department of Environmental Resources Management (ERM) has completed a Phase I Environmental Site Assessment (ESA) for the parcel of land located in the north-central Lake Worth Lagoon known as Peanut Island. The island comprises approximately 79 acres and is bordered to the east by the Lake Worth Inlet and to the west by the Atlantic Intracoastal Waterway. The island is a spoil island originally created in 1918, by the excavation of a channel between Lake Worth and the ocean. The periodic dredging of the Intracoastal Waterway and turning basins of the Port of Palm Beach occasionally contributes to the addition of spoil on the island. Exotic vegetation such as the Australian pine and Brazilian pepper are the dominant vegetation on site. A small community of mangroves and cabbage palms are found on the northwestern side of the island. A project plan for Peanut Island includes the creation of a maritime hammock, a shallow-water snorkeling reef, additional mangrove areas and other site improvements. The site is located in Range 43, Township 42, and Section 34.

A review of historical sources indicated that the only development on the site was the U.S. Coast Guard Station and Kennedy Bunker located on the southern end of the island. Electricity and potable water are currently provided at the southern end of the island.

Minor amounts of nonhazardous litter, two derelict boats and a vagrant campsite were observed on the beach areas of the island. The island is composed of fill and no subsurface explorations were conducted, therefore, buried debris or materials were not observed on the site. Based on the prior reported land uses of the island it is not likely that buried debris or materials will be found on the site.

The subject site was examined for "Recognized Environmental Conditions" in accordance with American Society of Testing and Materials (ASTM) Standard 1527-94. This assessment revealed no evidence of recognized environmental conditions in connection with the subject parcel.

Section 1135 Lake Worth Lagoon - Ecosystem Restoration
Project LWL Peanut Island Phase I ESA – EN Attachment D

2.0 INTRODUCTION

2.1 PURPOSE

The purpose of this investigation was to determine if there are any potential or existing environmental concerns associated with the subject site including; the presence of hazardous materials, the existence of soil or groundwater contamination, and the presence of environmental conditions or features that may be considered "Recognized Environmental Conditions" in accordance with the American Society of Testing and Materials (ASTM) Standard 1527-94. A Recognized Environmental Condition is defined as:

"The presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with the laws. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies" (ASTM Standard 1527-94, 1994).

2.2 SCOPE OF WORK

Phase I environmental site assessments typically provide current and historical information on land use and site conditions. This Phase I environmental site assessment included the following activities.

- Review of historical sources for evidence of prior land use which could result in soil or groundwater contamination.
- Review of regulatory agencies' enforcement and permitting records for indications of prior or existing contamination.
- Review of current and historical aerial photographs of the site and surrounding area.

- Review of published geologic information.
- Inspection of the property and surroundings.
- Interview with persons possessing knowledge of the property.

2.3 LIMITATIONS

ERM's environmental site assessment was limited to site conditions encountered on the day(s) of inspection, a review of reasonably ascertainable and relevant data, and information provided by outside parties and regulatory agencies. This assessment does not include subsurface explorations or laboratory analysis of soil or water. Environmental issues concerning buildings or structures such as asbestos containing materials and lead-based paint were not included in the focus of this assessment.

3.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT

3.1 SITE DESCRIPTION

The subject site is an island only accessible by boat. The island is oblong-shaped and approximately 79 acres in size. The former location of the United States Coast Guard occupies the southeastern end of the island and a semi-active dredging operation is found on the southwestern side of the island. Florida Power and Light (FPL) transmission lines run east and west on the southern third of the island. Australian pine trees and Brazilian pepper cover most of the island, although a small community of cabbage palm trees and mangroves are found on the northwestern side of the island. The terrain of the site is uneven and hilly.

3.1.1 Site Location

The subject site is located in Range 43, Township 42, and Section 34. The site is located within the north-central Lake Worth Lagoon, bordered to the east by the Lake Worth Inlet and to the west by the Atlantic Intracoastal Waterway. The Blue Heron Boulevard bridge is located north of the island. A site location map is presented in Appendix A, Figure A-2.

3.1.2 Regional Hydrogeology

The island is a manmade land mass which does not exhibit the typical aquifer characteristics found in southern Florida. Rainwater collects on the island and seeps down to available ground space. The saltwater surrounding the island similarly fills all available space from below. Due to the differing densities of freshwater and salt water, mixing does not readily occur and a "hydrostatic balance" is established at the fresh and salt water interface (Ghyben-Herberg Relationship).

3.1.3 Physical Setting

The subject site is seen on the Riviera Beach Quadrangle topographic map. The U.S. Geological Survey (U.S.G.S) 7.5 minute topographic map (Appendix A, Figure A-2) indicates that the highest elevation on site is approximately 22-feet above sea level. This elevation occurs at the central spoil staging area which is west of the Coast Guard Station. The initial publication of the map was 1945, photorevised in 1983. Elevations on the island may vary from the topographic map since spoil is occasionally deposited on the island.

3.1.4 Palm Beach County Wellfield Zone

The subject site is not located in a designated wellfield protection zone delineated on the May 1997, Palm Beach County Wellfield Zones of Influence Maps. Potable water is supplied by Riviera Beach to the island via an underwater pipeline originating from the Port of Palm Beach.

3.1.5 Soil Types

The soils on site are classified as Quarzipsamments, Shaped (QAB). These soils are described as sandy fill material, hauled in from other sources. These soils drain well and have a low organic content.

3.2 SITE INSPECTION

A site inspection was conducted by Graham Chantler and Karen Larson of ERM on October 9, 10, and 13, 1997. The subject site was inspected by a walk-through. The shoreline area, established trails, an FPL utility corridor, and areas off trails were inspected. The buildings comprising the former Coast Guard Station and Kennedy Bunker were also inspected. Photographs of the site are presented in Appendix B.

3.2.1 Current Property Use

The subject site is undeveloped with the exception of the southern end of the island where the former United States Coast Guard Station and Kennedy Bunker are located. Boaters occasionally moor at the north and eastern ends of the island for picnicking, swimming or snorkeling. Two picnic tables and a few trash barrels are located on the northeast side of the island. The trash barrels are periodically emptied by the Palm Beach County Parks and Recreation Department. A small vagrant campsite consisting of tents, chairs, a makeshift restroom and old boats are found on the north end of the island. Minor litter was observed around the entire island. All debris observed appeared nonhazardous.

A semi-active dredging operation is located just northwest of the Coast Guard Station. The dredged material or spoil from the occasional dredging of the Lake Worth Inlet and the Port of Palm Beach turning basins and slips is deposited on the island.

All buildings at the former Coast Guard Station were inspected. The station is no longer an active Coast Guard Station. The station buildings including the Kennedy Bunker will be converted into a maritime museum.

3.2.2 Current Uses of Adjoining Property

There are no bridges connecting Peanut Island to other adjacent parcels of land. However, the Port of Palm Beach is southeast of the site across the Intracoastal Waterway. Several mannas are located north of the Port of Palm Beach. Singer Island is located northeast of the island and Palm Beach is located southeast of the island. There are no adjacent land uses which appear to have caused or contributed to recognized environmental conditions on the subject site.

3.2.3 Past Uses of Property

Based on a review of historical aerial photographs and the topographic map, it appears that the subject site has never supported development other than the U. S. Coast Guard Station, Kennedy Bunker and the dredging operation. Historical information indicates that the island was created from spoil during 1918 and the Coast Guard Station was built on the island during 1936.

3.2.4 Hazardous Substances

Hazardous substances, were not observed on the subject site.

3.2.5 Hazardous Substance Containers

Hazardous substance containers were not observed on the subject site.

3.2.6 Solid Waste

Minor litter was observed on the subject site. Two rusted barges (approximately 30 x 15 feet in size) were observed on the western side of the island. Outside the western fence line of the Coast Guard Station, discarded lumber, cut vegetation and an old discarded cooler from a boat were found. Rusted pieces of metal and glass bottles were found on the eastern side of the island under the Florida Power and Light utility lines. All litter and debris observed appeared nonhazardous.

3.2.7 Pollutant Storage Tanks

One aboveground pollutant storage tank is located on the property of the former Coast Guard Station. The tank is in secondary containment and did not appear to be leaking. Pollutant storage tank facilities located near the subject site are discussed in Section 3.4.5.

3.2.8 PCBs

The electrical transformers observed on the subject site were in good condition and not rusting or leaking. No other equipment likely to contain PCBs was observed on the subject site.

3.3 HISTORICAL INFORMATION

In order to assist in identifying past uses of the subject property and surrounding areas, historical aerial photographs and a topographic map were reviewed.

3.3.1 Aerial Photograph Review

Historical aerial photographs dated 1965, 1971, 1977, and 1984 were reviewed for the subject site. All aerials were obtained from the Palm Beach County Department of Engineering reprographics office. Observations based on this aerial photographic record are as follows:

- 1965 The Coast Guard Station is seen on the southern end of the island. There is a cleared area on the north end of the island with trails connecting to the Coast Guard Station. Two barges are seen moored on the west side of the island. Vegetation covers most of the remaining areas of the island.

- 1971 The entire central portion of the island is void of vegetation and covered with fill. The buildings at the Coast Guard Station appear unchanged. Two barges are seen on the western side of the island.

- 1977 Vegetation has grown in the central area of the island. The western coastline of the island appears to have been filled. A Quonset hut previously seen on the Coast Guard property no longer appears. The concrete footprint of the building is visible.

RCRIS was also reviewed for facilities that generate hazardous waste located on subject property. No RCRIS sites were identified on the subject site.

3.4.5 Federal TRI List

TRI is a database used to store information on notifications about releases of more than 650 toxic chemicals and compounds to the environment. TRI was reviewed for releases occurring within a 0.5-mile radius of the subject site. No TRI sites were identified within the search radius.

3.4.6 DEP Stationary Tank Inventory

The Florida Department of Environmental Protection's STI list of pollutant storage tanks facilities was reviewed for pollutant storage tank sites and petroleum contaminated sites within a 0.5-mile radius. One registered storage tank site was found on Peanut Island. There is a 500 gallon aboveground fuel tank located on the Coast Guard property. The tank is used to supply an emergency generator. File information reviewed indicates that there are no records of releases or discharges from the aboveground tank. There was also a small above ground oil/water separator tank located at the Coast Guard Station. The oil/water separator was used to contain oily bilge water pumped out of Coast Guard boats. During December 1994, an assessment was conducted to determine the extent of soil contamination surrounding the separator on the Coast Guard property. Soil contamination was found west of the tank, and the tank and approximately 35 tons of excessively contaminated soils were removed from the site. Petroleum contamination identified at this site has been remediated and would not be considered a recognized environmental condition.

Several petroleum contaminated sites are located within the 0.5-mile search radius. Since all of the sites are separate from the subject site by water, they would not be an environmental concern for the subject site.

3.4.7 Solid Waste Authority (SWA) Inventory of Solid Waste Sites

The SWA Inventory of Solid Waste Sites is a compilation of information obtained from numerous sources concerning the location and disposition of solid waste sites in Palm Beach County. These sites include dumps, landfills, solid waste management facilities, waste transfer stations, selected hazardous waste spills, burial sites, and sludge land application sites. No solid waste sites were located within the search distance.

4.0 CONCLUSIONS AND RECOMMENDATIONS

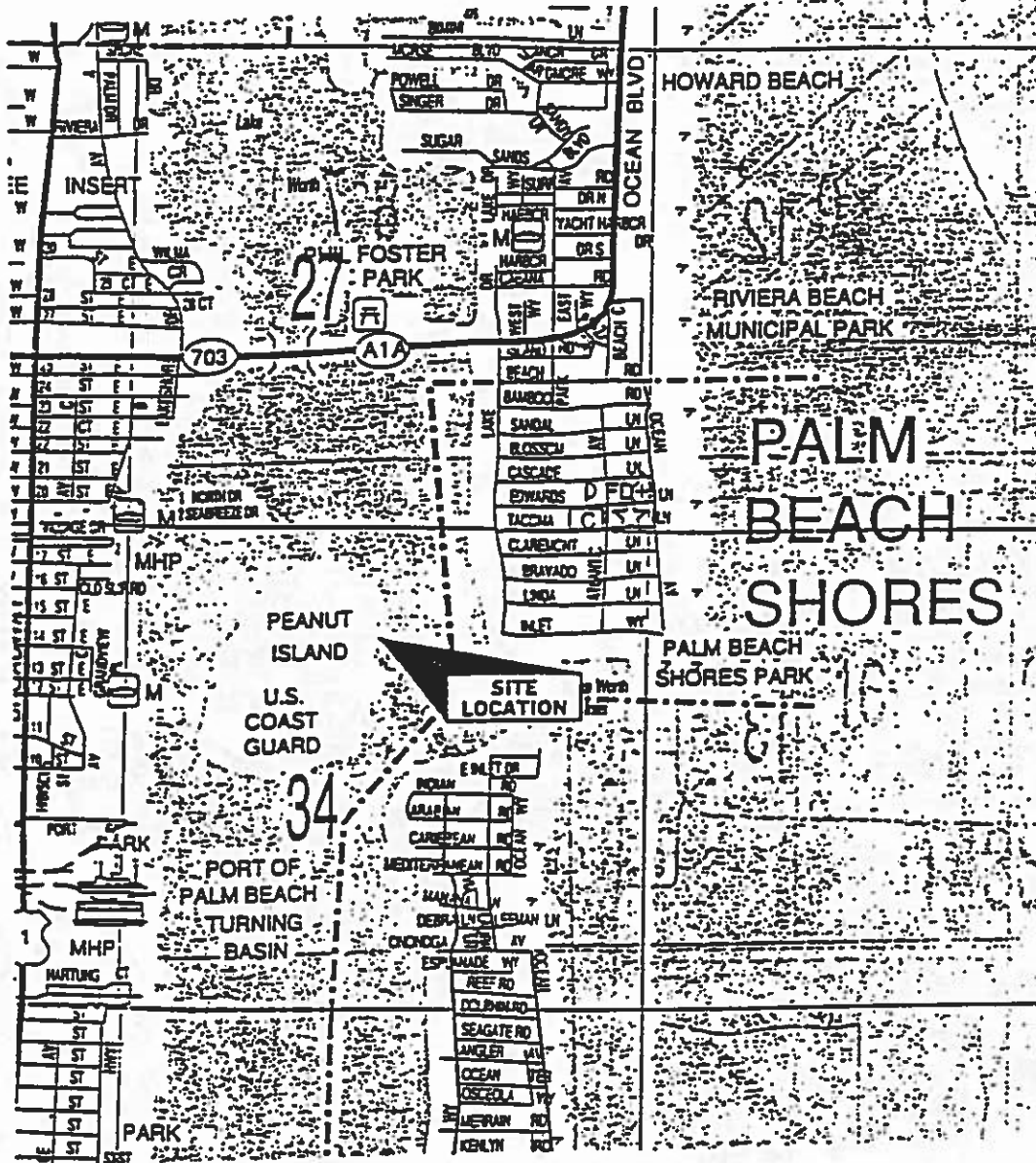
The Palm Beach County Department of Environmental Resources Management has performed a Phase I Environmental Site Assessment for a parcel of land located in the north-central Lake Worth Lagoon known as Peanut Island.


Minor litter was observed around the entire island. Two rusted barges, pieces of metal, glass bottles, discarded lumber, cut vegetation and an old discarded cooler from a boat were found. Additionally a small vagrant campsite consisting of tents, chairs, a makeshift restroom and old boats were found on the north end of the island in the area planned for restoration. All observed litter and debris appeared nonhazardous.

The subject parcel was examined for "Recognized Environmental Conditions" in accordance with American Society of Testing and Materials (ASTM) Standard 1527-94. This assessment revealed no evidence of recognized environmental conditions in connection with the subject parcel. Based on a review the available information and on-site inspections, no additional investigation of the area for soil or groundwater contamination appears necessary at this time.

**APPENDIX A
LOCATION MAPS**





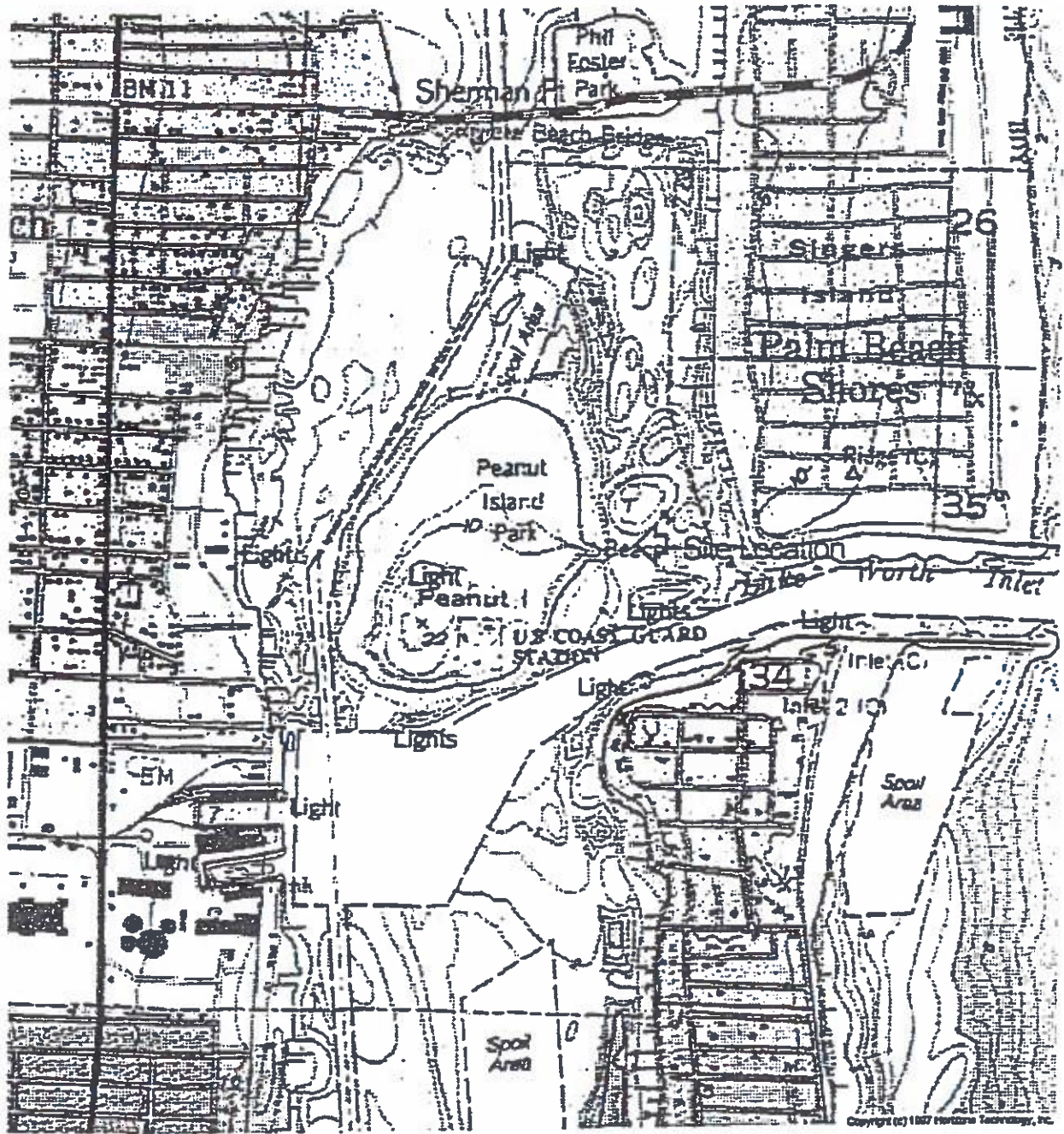


PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

Figure A-1

Palm Beach County
 Department of Environmental Resources Management
 Environmental Review & Natural Areas Division

Date: November 1997

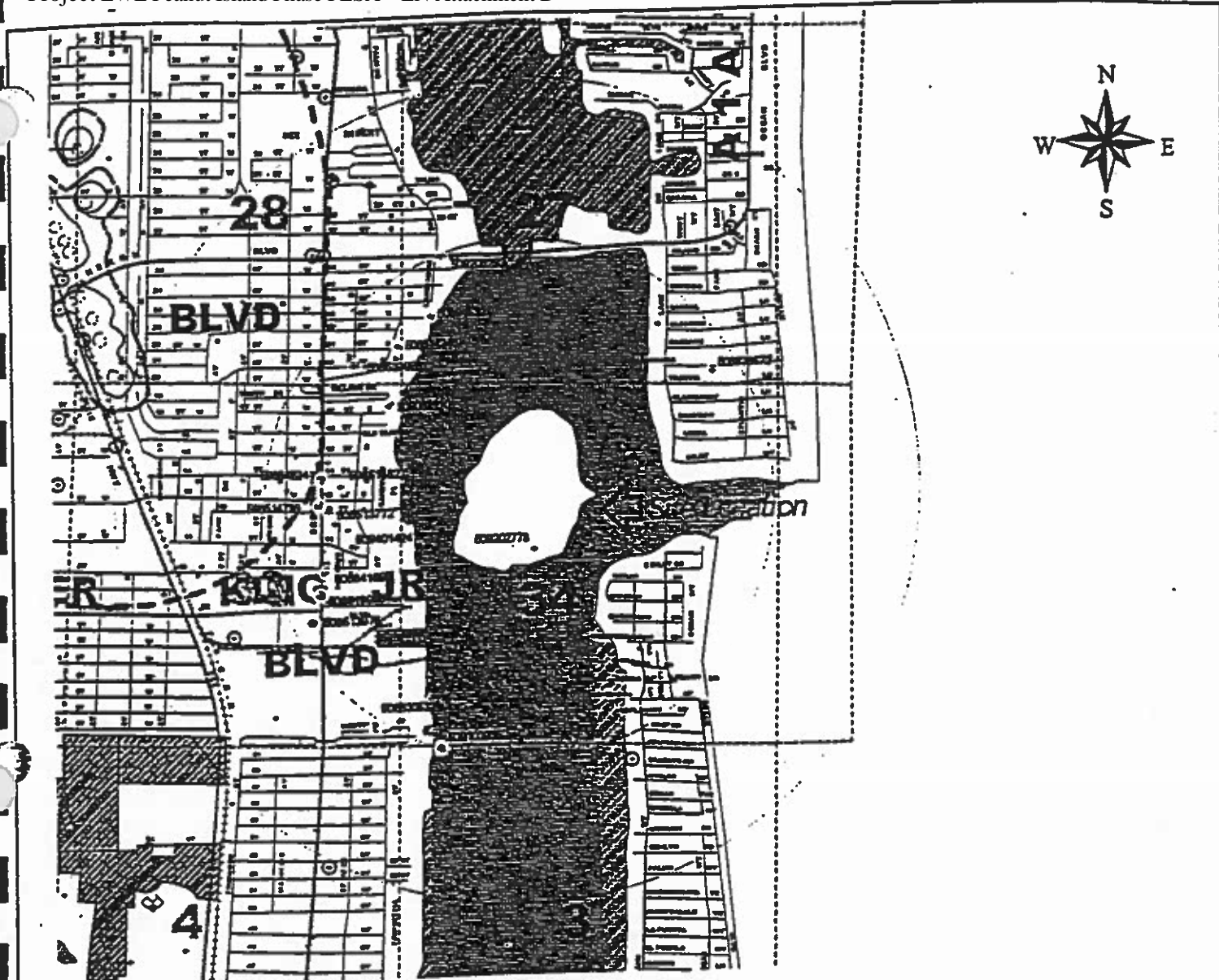


Phase I Environmental Site Assessment for Peanut Island

FIGURE A-2

prepared by:
Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

November 1997



Sites located within search radius are shown in magenta and labeled.
 Areas within municipal limits are shaded in yellow.

- Petroleum Cleanup Sites
- Registered Storage Tanks
- ◇ Solid Waste Sites
- ◇ CERCLIS
- ◇ Treatment, Storage and Disposal (RCRA)
- ◇ National Priorities List

- Environmentally Sensitive Lands**
- Not Preserved ESL
 - Exempt
 - Publicly Owned Preserves
 - Privately Owned Preserves
 - Proposed Acquisition Sites
 - County Bond Purchased ESL

**Wellfield Protection
 Zones of Influence**

- Zone 1
- Zone 2
- Zone 3
- Zone 4

⊕ Non-transient/Non-community PWS Wells

Note: The information presented represents the most readily available data.
 No guarantee is made as to the completeness or accuracy of the information displayed.
 Consult appropriate County Staff for final determination.



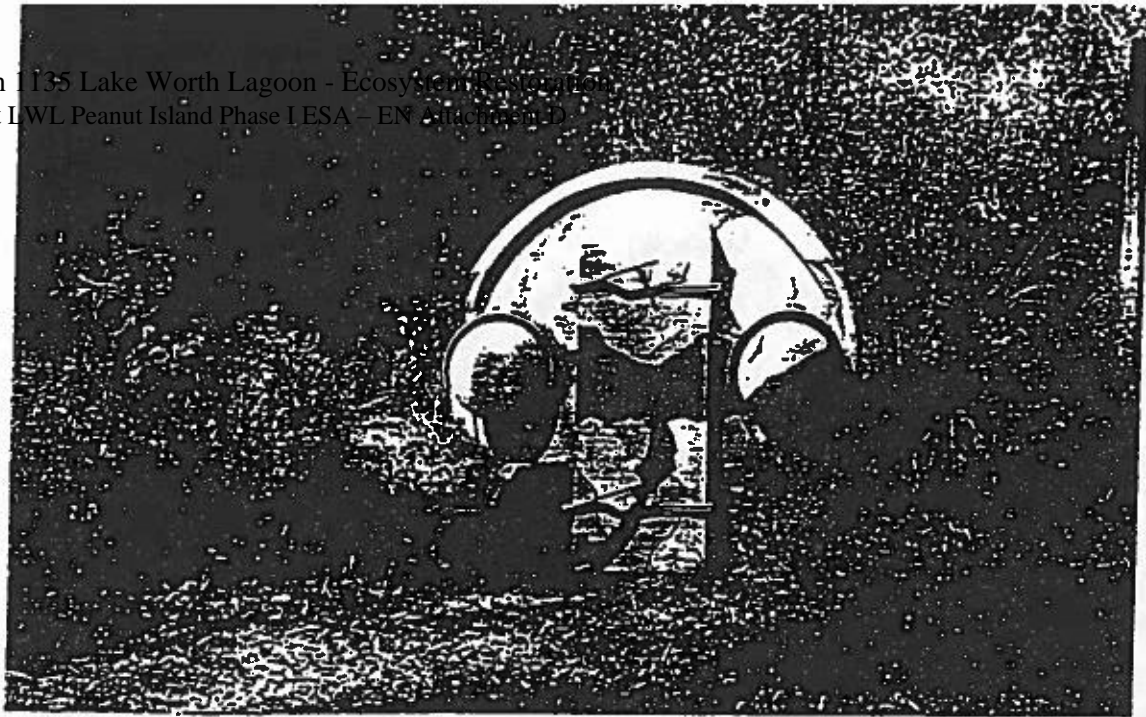
PHASE I ENVIRONMENTAL SITE ASSESSMENT

Peanut Island
 Figure A-3

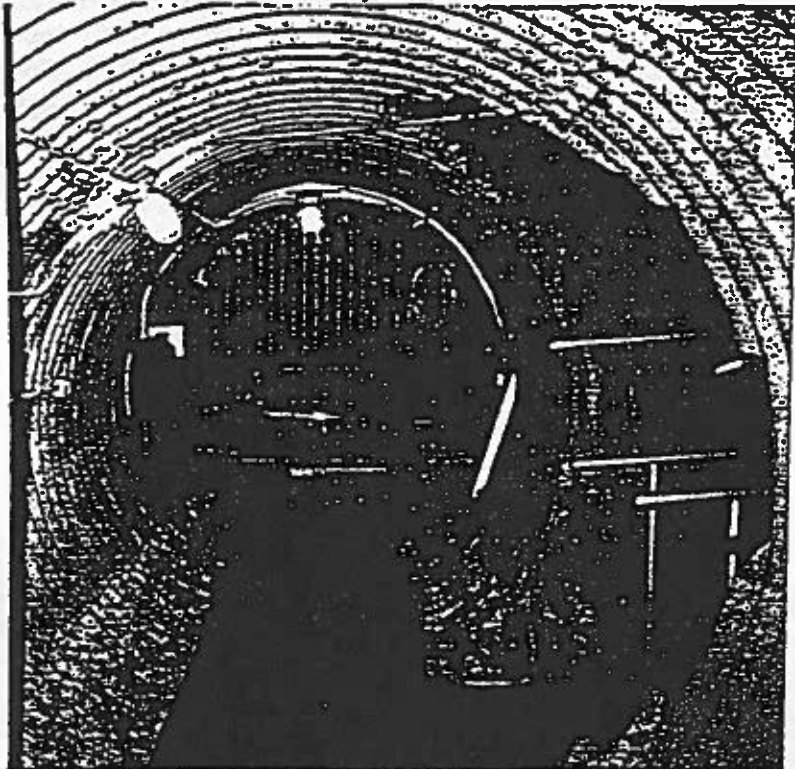
Palm Beach County
 Environmental Resources Management
 Environmental Review & Natural Areas Division

November 1997

**APPENDIX B
PHOTOGRAPHS**



Entrance to Former Kennedy Bunker I



Inside Former Kennedy Bunker I

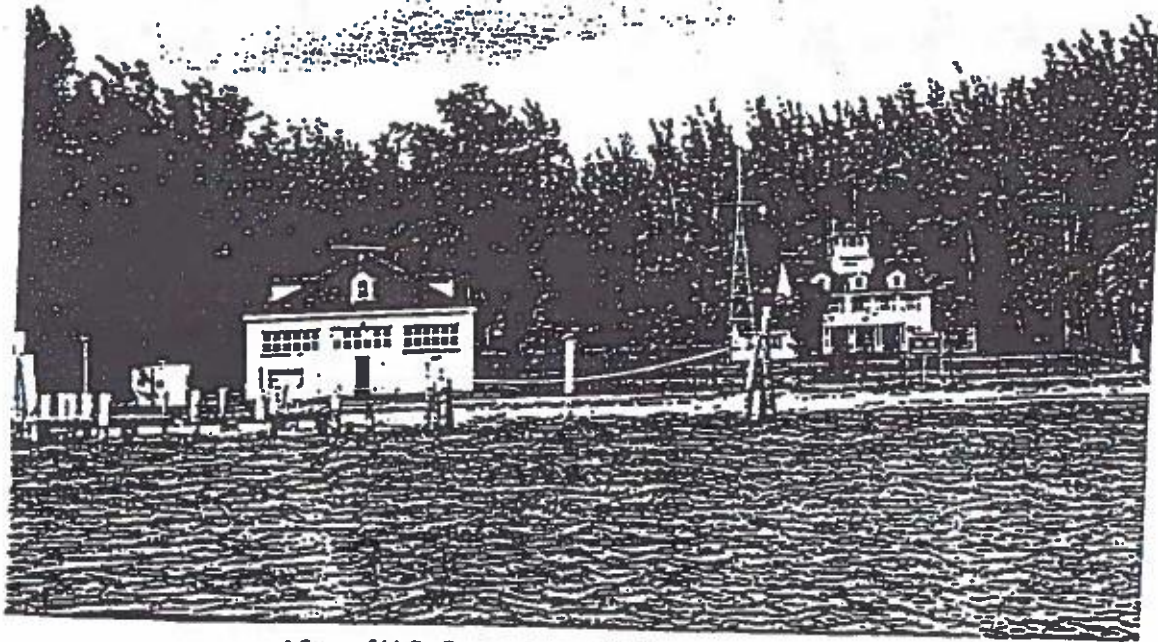


PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

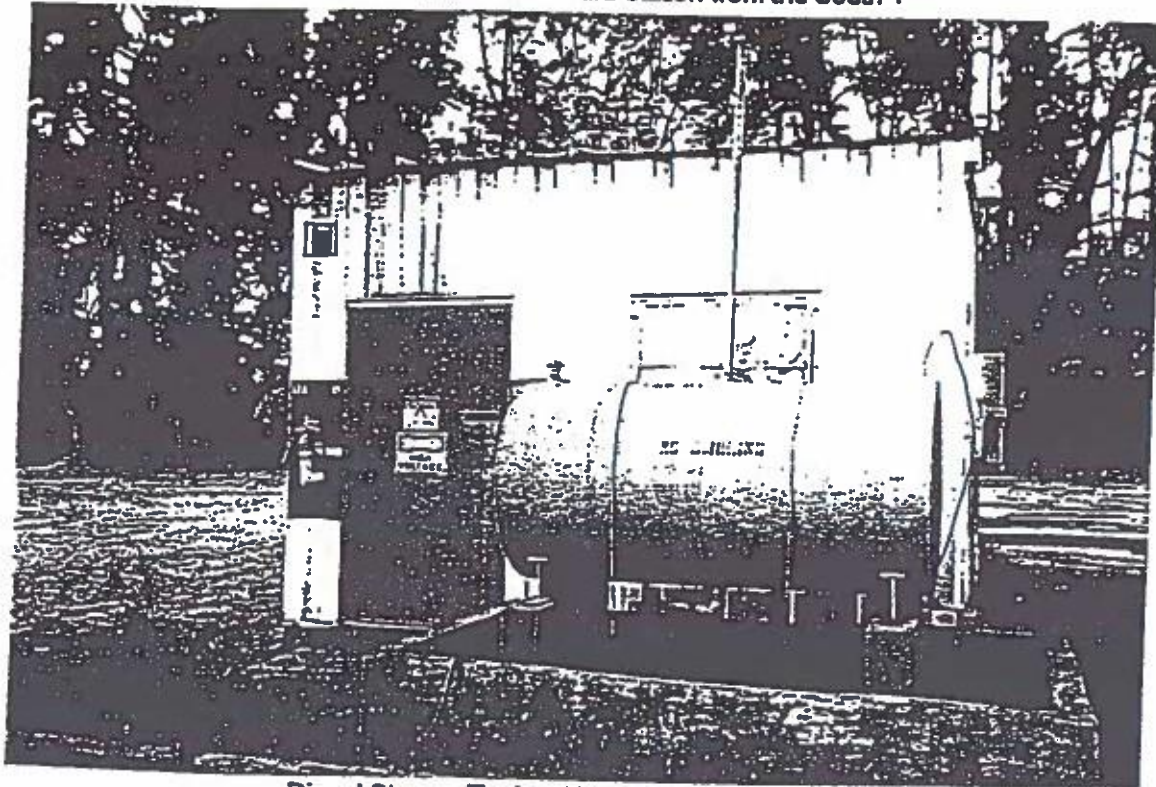
Figure B-1

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997



View of U.S. Coast Guard Station from the South I



Diesel Storage Tank at U.S. Coast Guard Station I

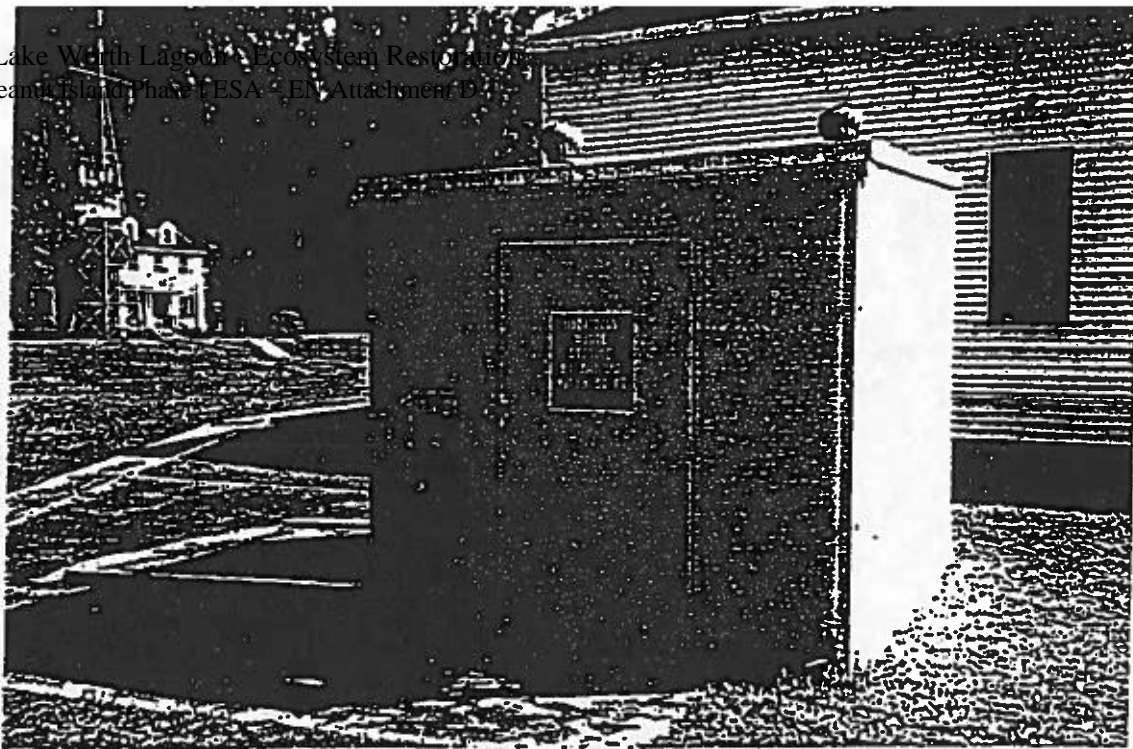


PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

Figure B-2

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997



Hazardous Waste Storage Area on U.S. Coast Guard Station I



Paint Storage Area at U.S. Coast Guard Station I

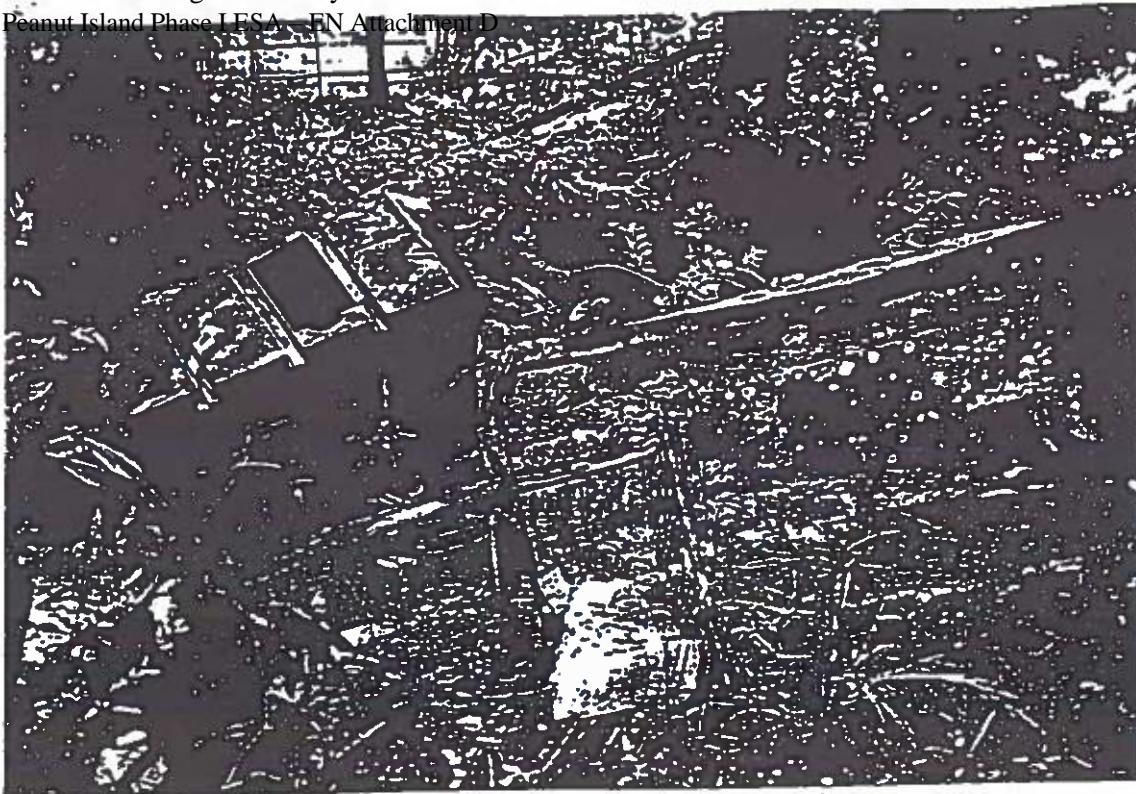


PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

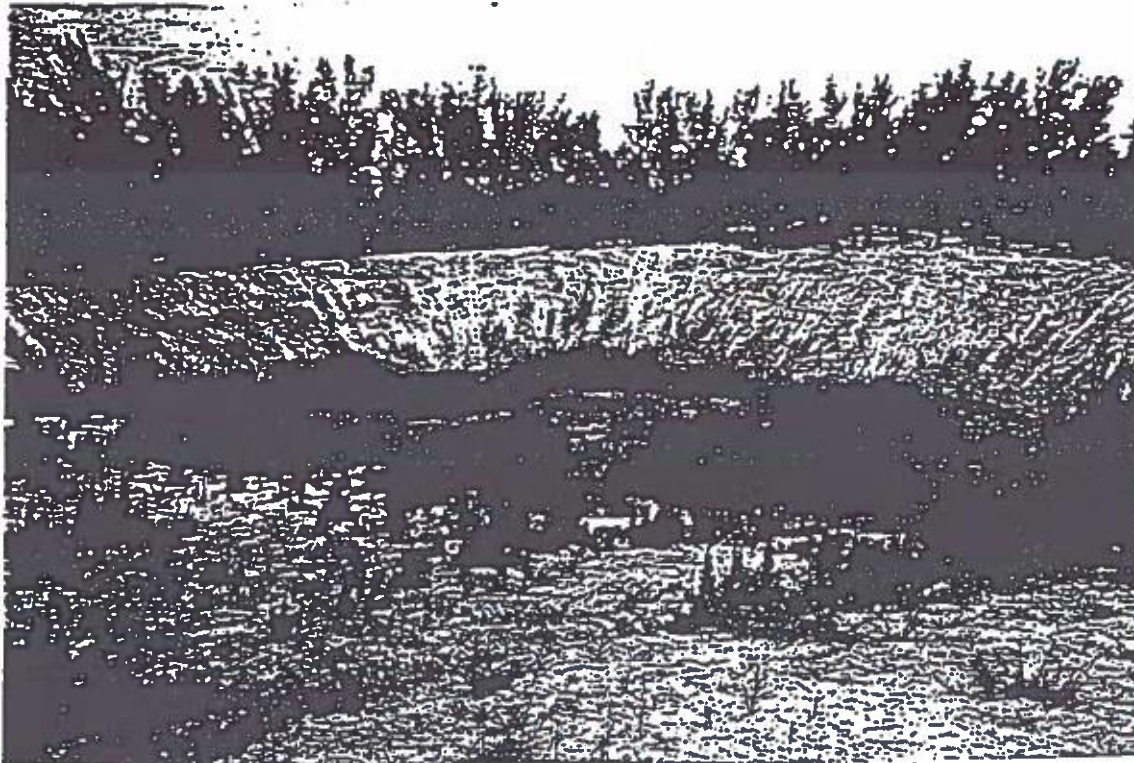
Figure B-3

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997



Trash Mound adjacent to U.S. Coast Guard Station I



View of Central Spoil Staging Area I

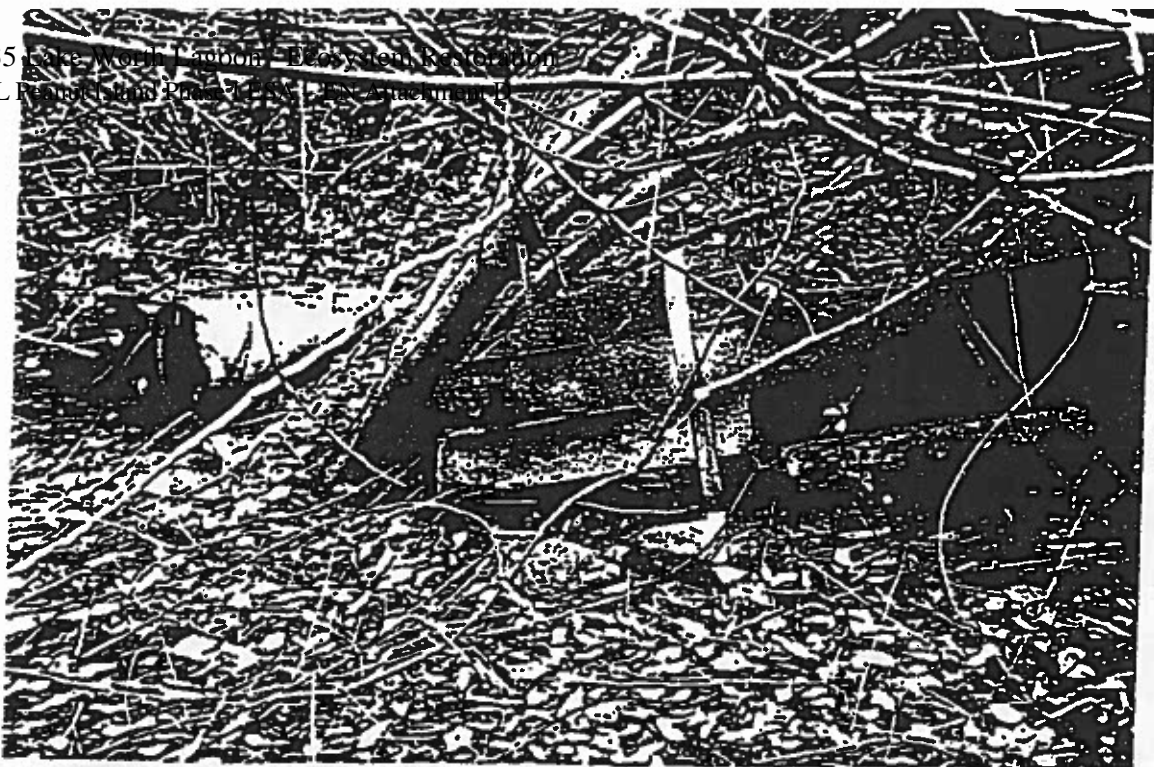


PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

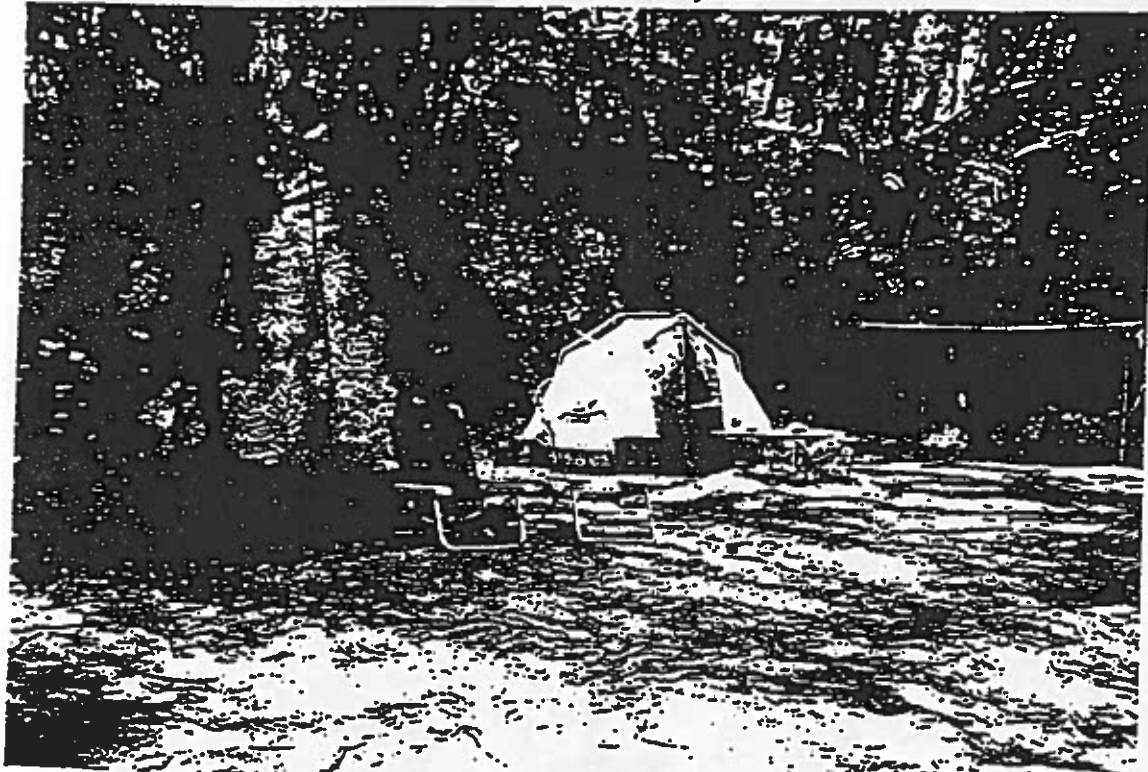
Figure B-4

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997



Old Electrical Equipment in Utility Easement I



View of Homeless Camp on the North side of Island I



PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

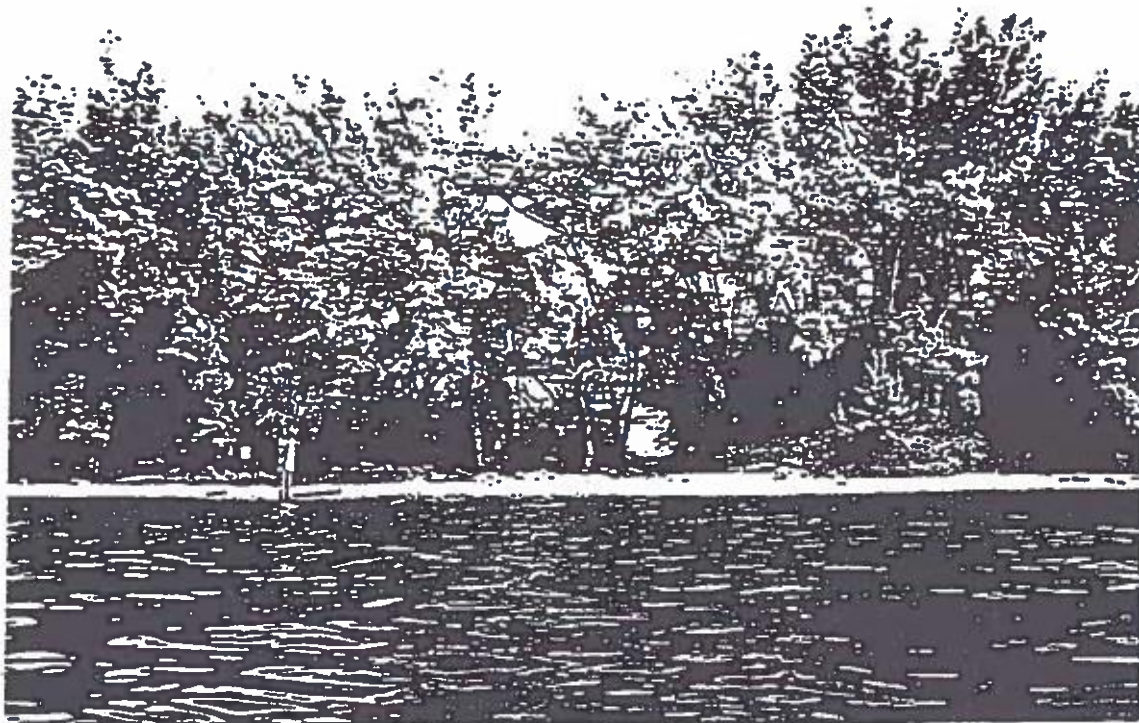
Figure B-5

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997



View Facing East along Utility Easement 1



View of West Side of Island Facing East 1



PHASE I ENVIRONMENTAL SITE ASSESSMENT
Peanut Island

Figure B-6

Palm Beach County
Department of Environmental Resources Management
Environmental Review & Natural Areas Division

Date: November 1997

ATTACHMENT E

GEOTECHNICAL DATA

PALM BEACH COUNTY

**1996 COASTAL SEDIMENT SAMPLING
& ANALYSIS**

Contract #95073A

**INTRACOASTAL WATERWAY (ICW) CORE LOGS,
SEDIMENT ANALYSIS DATA SHEETS, AND PLOTS**

Scientific Environmental Applications, Inc.

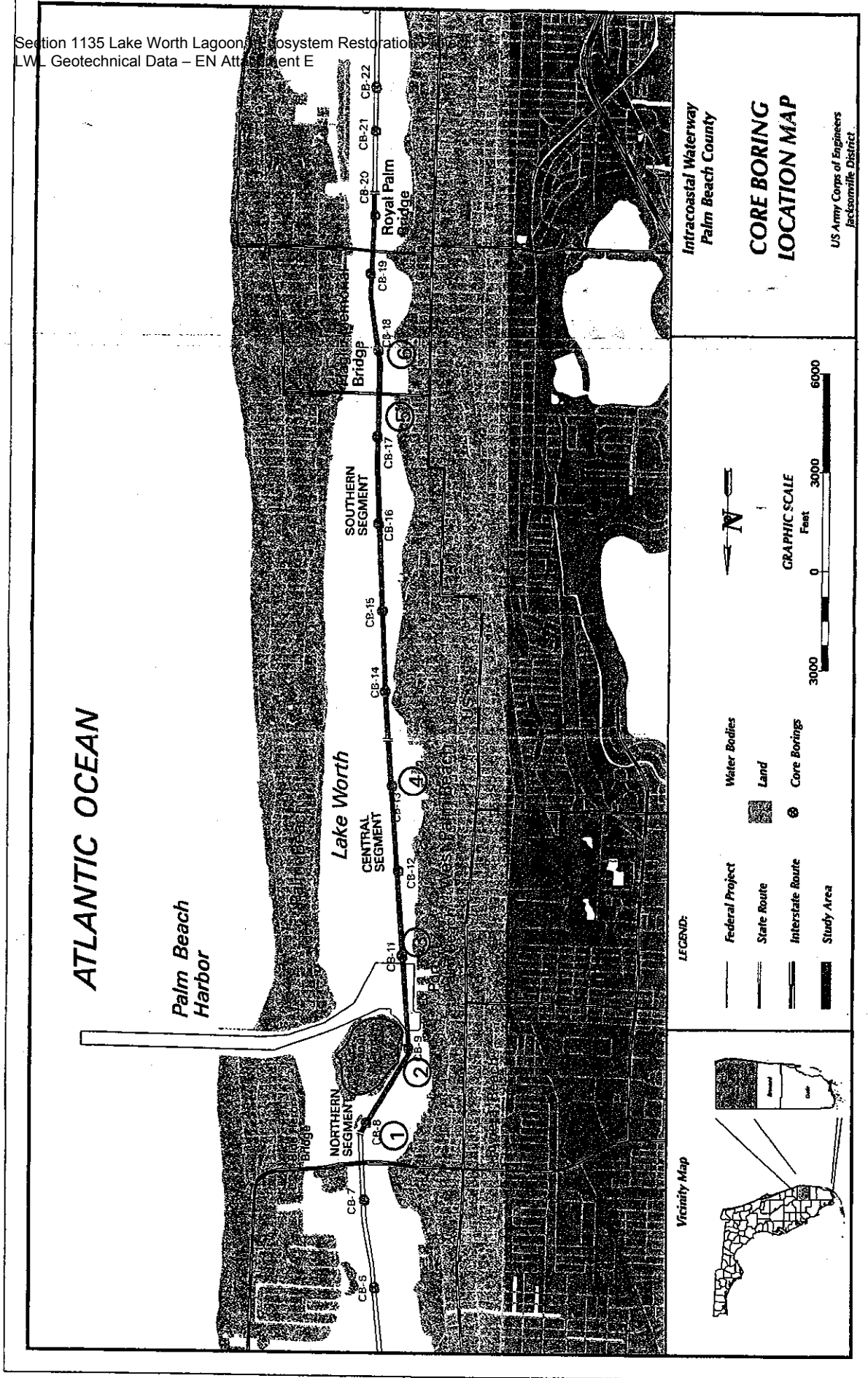


Figure 7. Core Boring Location Map

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 1
1. PROJECT IWW—Palm Beach Harbor		10. SIZE AND TYPE OF BIT 4" Vibracore		
2. LOCATION (Coordinates or Station) 808085.9 E 907972.7 N		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLW		
3. DRILLING AGENCY SEA, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL Alpine Pneumatic Vibracore		
4. HOLE NO. (As shown on drawing title and file number) IWW CB-1		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed:		
5. NAME OF DRILLER G. Zarillo		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER		
7. WATER DEPTH		16. DATE HOLE STARTED COMPLETED 7/28/96 7/28/96		
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE -10.9		
9. TOTAL DEPTH OF HOLE 8.3'		18. TOTAL CORE RECOVERY FOR BORING		
		19. SIGNATURE OF GEOLOGIST G. Zarillo		

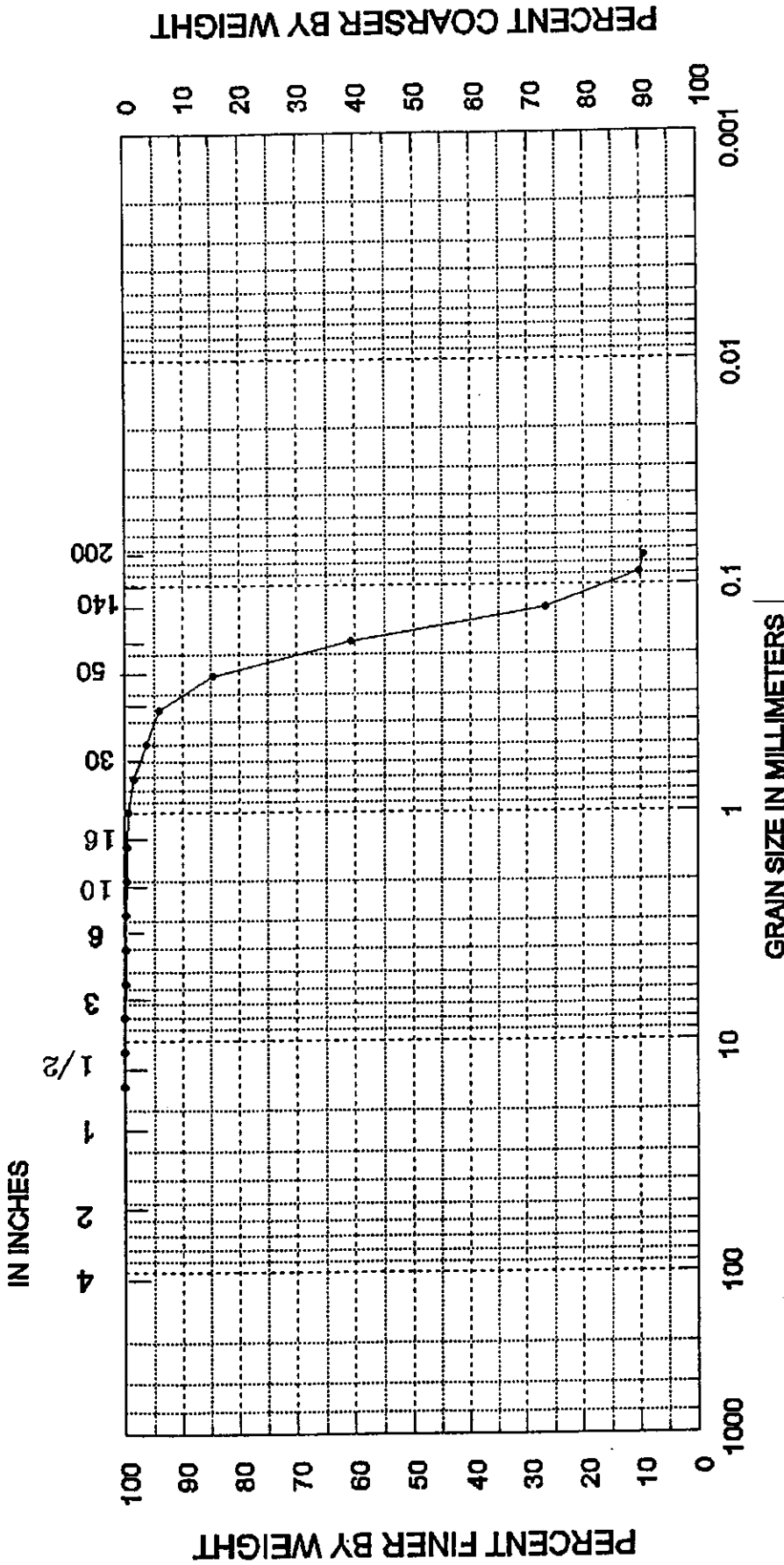
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS
-10.9	0.0		Light-gray-to-tan, fine sand. (SP)	100		
-14.5	3.6		Brown, fine sand—wet. (SP)	100	4.5	5.0'–5.5' Very wet
-16.8	5.9		Light brown, fine sand. (SP)			
-17.5	6.6		Light tan, fine sand. (SP)	100		
-19.2	8.3		End at 8.3'			

Sediment Analysis Data Sheet

IWWCB1 4.5

Sieve	Size (mm)	Phi size	Wt	Wt %	Cuml %	Folk Statistics		
						phi	mm	
	16.00	-4.00	0.00	0.00	0.00			
	11.31	-3.50	0.00	0.00	0.00			
	8.00	-3.00	0.00	0.00	0.00			
	5.66	-2.50	0.05	0.15	0.15	5% :	1.30	0.41
5	4.00	-2.00	0.01	0.04	0.19	16% :	2.01	0.25
7	2.83	-1.50	0.00	0.01	0.21	25% :	2.20	0.22
10	2.00	-1.00	0.04	0.13	0.33	50% :	2.66	0.16
14	1.41	-0.50	0.02	0.06	0.39	75% :	3.05	0.12
18	1.00	0.00	0.07	0.23	0.62	84% :	3.32	0.10
25	0.71	0.50	0.31	0.99	1.61	95% :	3.90	0.07
35	0.50	1.00	0.65	2.05	3.67			
45	0.35	1.50	0.70	2.21	5.88	Med.	2.66	0.16
60	0.25	2.00	3.03	9.57	15.45	Mean	2.64	0.16
80	0.18	2.50	7.61	24.04	39.49	St Dev.	0.72	
120	0.13	3.00	10.71	33.84	73.33	Skew	-0.01	
170	0.09	3.50	5.25	16.58	89.91	Kurt.	1.25	
200	0.07	3.75	0.25	0.79	90.70			
Pan			0.03	0.10	90.80			
Total			28.74	90.80	90.80			
						Moment	Statistics	
							Phi	mm
Cu =	1.74		Gravel		0 %	Mean	2.72	0.15
			Coarse Sand		0 %	St. Dev.	0.69	0.62
			Med. Sand		4 %	Skewness	-2.01	
Cc =	0.94		Fine Sand		86 %	Kurtosis	11.54	

U.S. STANDARD SIEVE OPENING IN INCHES U.S. STANDARD SIEVE NUMBERS HYDROMETER



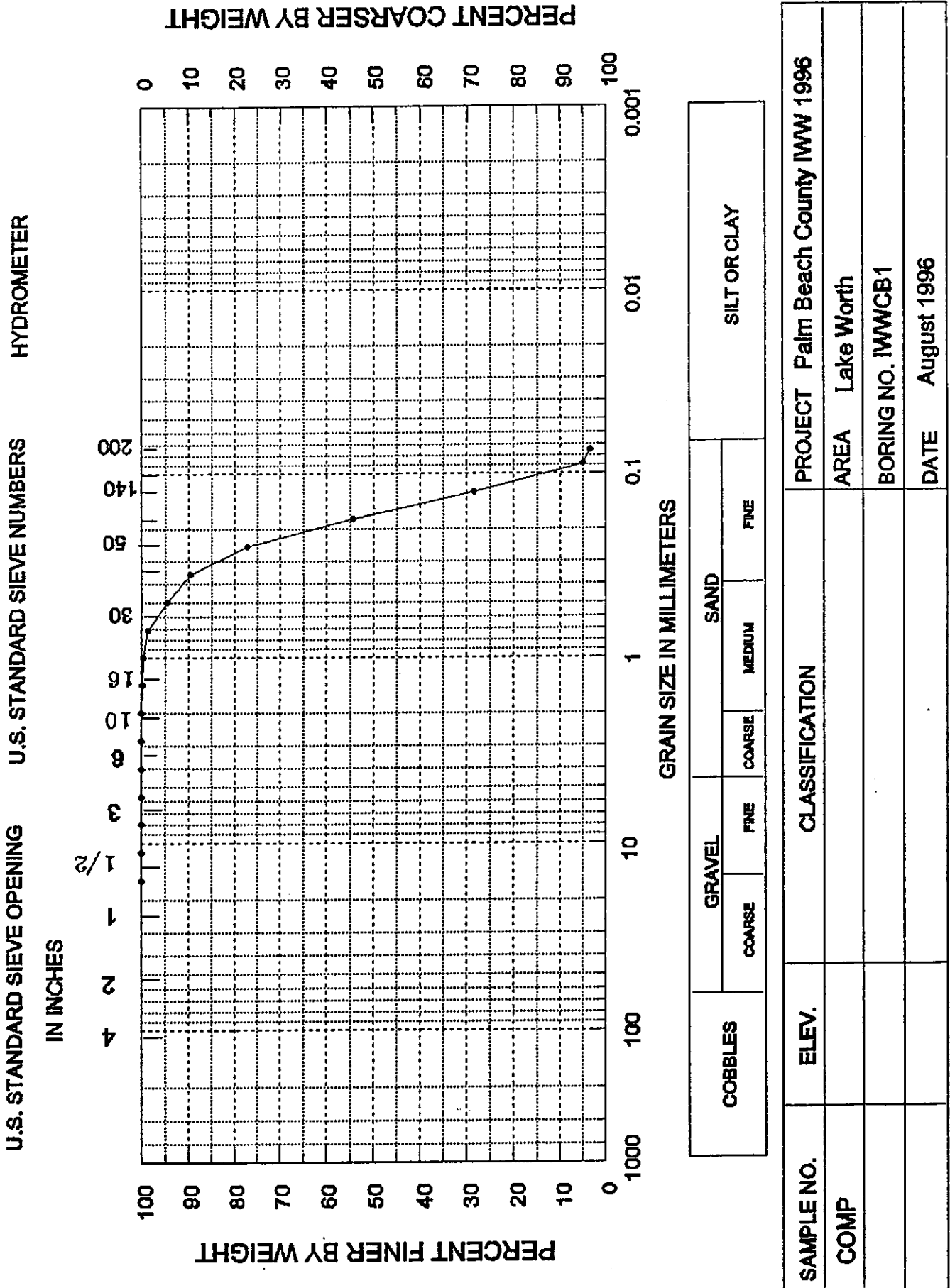
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV.	CLASSIFICATION	PROJECT
4.5	-15.4	Fine Sand SP	Palm Beach County IWW 1996
			AREA Lake Worth
			BORING NO. IWWCB 1
			DATE August 1996

Sediment Analysis Data Sheet

IWWCB1 COMP

Sieve	Size (mm)	Phi size	Wt	Wt %	Cuml %	Folk Statistics	
						phi	mm
	16.00	-4.00	0.00	0.00	0.00		
	11.31	-3.50	0.00	0.00	0.00		
	8.00	-3.00	0.00	0.00	0.00		
	5.66	-2.50	0.00	0.00	0.00	5% :	0.93 0.53
5	4.00	-2.00	0.00	0.00	0.00	16% :	1.73 0.30
7	2.83	-1.50	0.03	0.07	0.07	25% :	2.05 0.24
10	2.00	-1.00	0.01	0.01	0.09	50% :	2.58 0.17
14	1.41	-0.50	0.06	0.17	0.25	75% :	3.07 0.12
18	1.00	0.00	0.08	0.23	0.48	84% :	3.26 0.10
25	0.71	0.50	0.32	0.94	1.42	95% :	3.50 0.09
35	0.50	1.00	1.43	4.18	5.60		
45	0.35	1.50	1.65	4.82	10.42	Med.	2.58 0.17
60	0.25	2.00	4.24	12.38	22.80	Mean	2.40 0.19
80	0.18	2.50	7.85	22.95	45.75	St Dev.	0.77
120	0.13	3.00	8.81	25.77	71.51	Skew	-0.20
170	0.09	3.50	8.06	23.57	95.09	Kurt.	1.03
200	0.07	3.75	0.50	1.45	96.54		
Pan			0.06	0.16	96.70		
Total			33.08	96.70	96.70		
						Moment Statistics	
							Phi mm
Cu =	2.02		Gravel		0 %	Mean	2.68 0.16
			Coarse Sand		0 %	St. Dev.	0.75 0.59
			Med. Sand		8 %	Skewness	-1.03
Cc =	0.89		Fine Sand		89 %	Kurtosis	4.36



SAMPLE NO.	ELEV.	CLASSIFICATION	PROJECT
COMP			PROJECT Palm Beach County MW 1996
			AREA Lake Worth
			BORING NO. IWWCB1
			DATE August 1996

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 1
1. PROJECT IWW—Palm Beach Harbor		10. SIZE AND TYPE OF BIT 4" Vibrocore		
2. LOCATION (Coordinates or Station) 808880.2 E 805451.1 N		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLW		
3. DRILLING AGENCY SEA, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL Alpine Pneumatic Vibrocore		
4. HOLE NO. (As shown on drawing title and file number) IWW CB-2		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed:		
5. NAME OF DRILLER G. Zarillo		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER		
7. WATER DEPTH		16. DATE HOLE STARTED COMPLETED 7/28/96 7/28/96		
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE -11.7		
9. TOTAL DEPTH OF HOLE 6.6'		18. TOTAL CORE RECOVERY FOR BORING		
		19. SIGNATURE OF GEOLOGIST G. Zarillo		

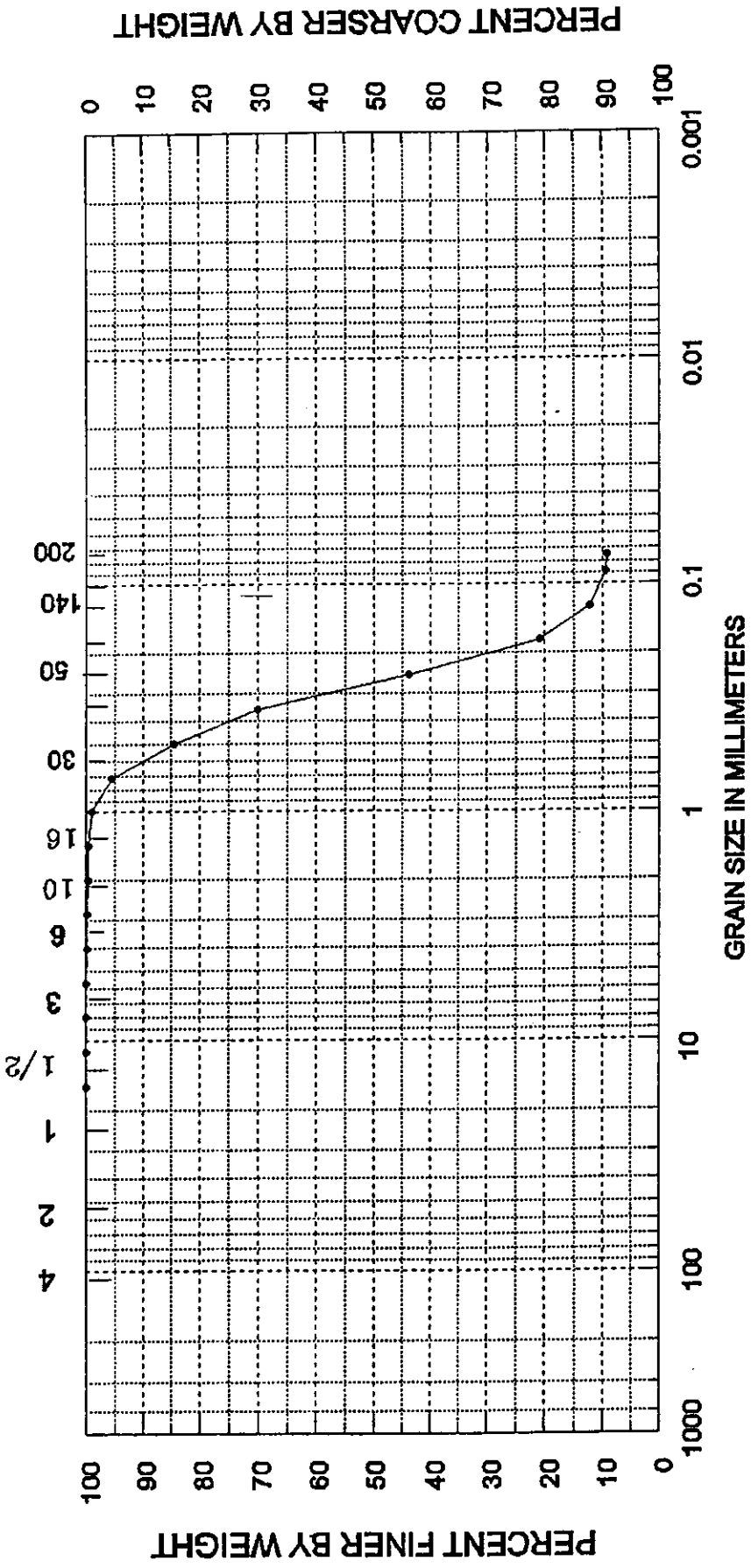
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS
-11.7	0.0					
-12.4	0.7	[Pattern]	Tan-orange, fine sand. (SP)	100		0.0'–3.0' Iron oxide staining
		[Pattern]	Dark-tan-orange, fine sand. (SP)		2.5	
-14.6	2.9	[Pattern]	Gray, fine sand. (SP)	100		
-16.5	4.8	[Pattern]	Light gray, fine sand. (SP)			
-18.2	6.6	[Pattern]	End at 6.6'	100		5.7'–Bottom Dark gray, organic stain, trace shell material

Sediment Analysis Data Sheet

IWWCB2 2.5

Sieve	Size (mm)	Phi size	Wt Wt	Wt %	Cuml %	Folk Statistics	
						phi	mm
	16.00	-4.00	0.00	0.00	0.00		
	11.31	-3.50	0.00	0.00	0.00		
	8.00	-3.00	0.00	0.00	0.00		
	5.66	-2.50	0.00	0.00	0.00	5% :	0.52 0.70
5	4.00	-2.00	0.05	0.16	0.16	16% :	1.01 0.50
7	2.83	-1.50	0.03	0.08	0.24	25% :	1.33 0.40
10	2.00	-1.00	0.02	0.06	0.30	50% :	1.88 0.27
14	1.41	-0.50	0.04	0.13	0.43	75% :	2.41 0.19
18	1.00	0.00	0.19	0.61	1.04	84% :	2.77 0.15
25	0.71	0.50	1.10	3.57	4.61	95% :	3.90 0.07
35	0.50	1.00	3.39	11.04	15.65		
45	0.35	1.50	4.40	14.32	29.96	Med.	1.88 0.27
60	0.25	2.00	8.07	26.28	56.25	Mean	2.02 0.25
80	0.18	2.50	7.05	22.98	79.23	St Dev.	0.95
120	0.13	3.00	2.67	8.71	87.93	Skew	0.10
170	0.09	3.50	0.83	2.71	90.64	Kurt.	1.28
200	0.07	3.75	0.07	0.23	90.87		
Pan			0.01	0.03	90.90		
Total			27.91	90.90	90.90		
						Moment	Statistics
							Phi mm
Cu =	3.23		Gravel		0 %	Mean	1.98 0.25
			Coarse Sand		0 %	St. Dev.	0.75 0.59
			Med. Sand		23 %	Skewness	-0.59
Cc =	1.39		Fine Sand		68 %	Kurtosis	4.41

U.S. STANDARD SIEVE OPENING IN INCHES U.S. STANDARD SIEVE NUMBERS HYDROMETER



COBBLES	GRAVEL			SAND			SILT OR CLAY
	COARSE	FINE		COARSE	MEDIUM	FINE	

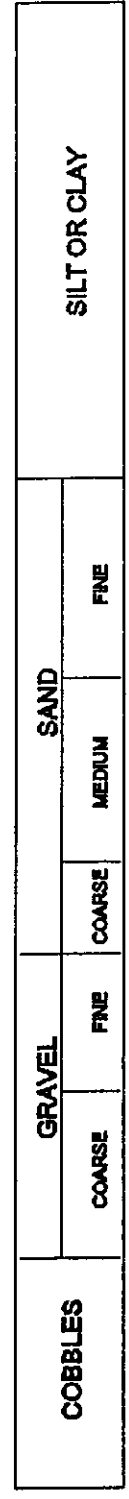
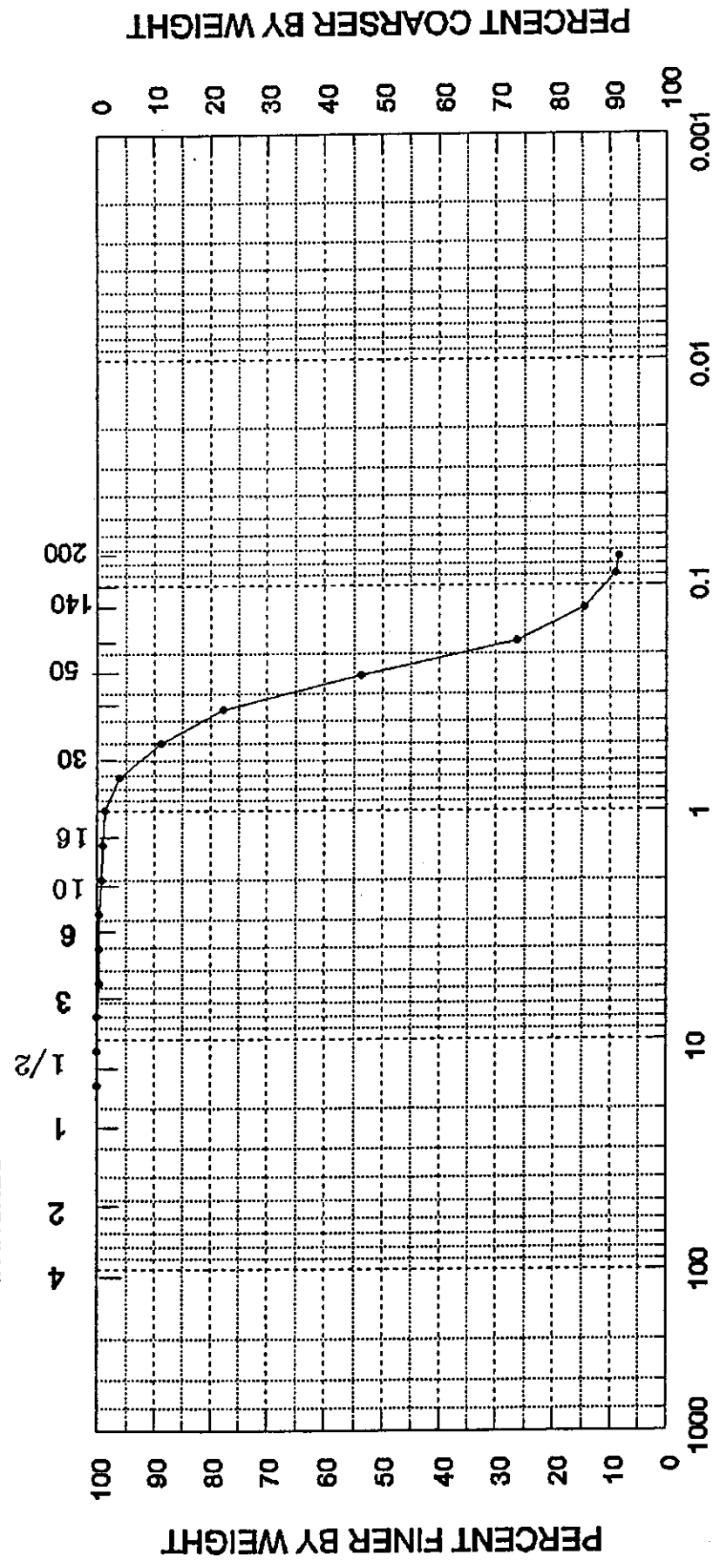
SAMPLE NO.	ELEV.	CLASSIFICATION	PROJECT Palm Beach County IWW 1996
2.5	-14.2	Fine Sand SP	AREA Lake Worth
			BORING NO. IWWCB 2
			DATE August 1996

Sediment Analysis Data Sheet

IWWCB2 COMP

Sieve	Size (mm)	Phi size	Wt Wt	Wt %	Cuml %	Folk Statistics	
						phi	mm
	16.00	-4.00	0.00	0.00	0.00		
	11.31	-3.50	0.00	0.00	0.00		
	8.00	-3.00	0.00	0.00	0.00		
	5.66	-2.50	0.15	0.46	0.46	5% :	0.58 0.67
5	4.00	-2.00	0.00	0.00	0.46	16% :	1.22 0.43
7	2.83	-1.50	0.00	0.00	0.46	25% :	1.56 0.34
10	2.00	-1.00	0.08	0.26	0.72	50% :	2.07 0.24
14	1.41	-0.50	0.06	0.18	0.90	75% :	2.56 0.17
18	1.00	0.00	0.13	0.41	1.31	84% :	2.93 0.13
25	0.71	0.50	0.81	2.55	3.86	95% :	0.00 1.00
35	0.50	1.00	2.34	7.36	11.22		
45	0.35	1.50	3.50	11.03	22.25	Med.	2.07 0.24
60	0.25	2.00	7.68	24.18	46.43	Mean	1.36 0.39
80	0.18	2.50	8.65	27.24	73.66	St Dev.	0.34
120	0.13	3.00	3.78	11.91	85.58	Skew	3.08
170	0.09	3.50	1.74	5.48	91.06	Kurt.	-0.24
200	0.07	3.75	0.20	0.61	91.67		
Pan			0.20	0.63	92.30		
Total			29.31	92.30	92.30		
						Moment Statistics	
							Phi mm
Cu =	2.90		Gravel		0 %	Mean	2.15 0.22
			Coarse Sand		0 %	St. Dev.	0.82 0.57
			Med. Sand		16 %	Skewness	-1.27
Cc =	1.32		Fine Sand		75 %	Kurtosis	7.90

U.S. STANDARD SIEVE OPENING IN INCHES U.S. STANDARD SIEVE NUMBERS HYDROMETER



SAMPLE NO.	ELEV.	CLASSIFICATION	PROJECT
COMP		Fine Sand SP	Palm Beach County IWW 1996
			AREA Lake Worth
			BORING NO. IWWCB2
			DATE August 1996

Appendix A

1996 Intracoastal Waterway Samples

Summary Percentages of Mud and Carbonate

Palm Beach County 1996

Sample #	Mud%	Sand%	Org Carb%	CaCO3%
IWWCB1 4.5	9.15%	90.85%	6.02%	18.78%
IWWCB1 COMP	3.30%	96.70%	0.62%	3.02%
IWWCB2 2.5	9.07%	90.93%	7.78%	19.44%
IWWCB2 COMP	7.66%	92.34%	0.51%	4.83%
IWWCB3 1.5	6.15%	93.85%	7.64%	19.23%
IWWCB3 COMP	3.70%	96.30%	1.07%	10.10%
IWWCB4 4.0	3.51%	96.49%	0.81%	18.14%
IWWCB4 COMP	7.70%	92.30%	1.78%	26.62%
IWWCB5 2.5	30.10%	69.90%	23.20%	75.95%
IWWCB5 COMP	17.49%	82.51%	4.94%	42.51%
IWWCB6 3.0	14.42%	85.58%	12.59%	51.93%
IWWCB6 COMP	7.40%	92.60%	1.68%	30.81%
IWWCB7 1.5	0.67%	99.33%	0.61%	20.27%
IWWCB7 3.0	2.92%	97.08%	6.81%	18.77%
IWWCB7 6.0	3.95%	96.05%	0.51%	14.31%
IWWCB7 COMP	3.11%	96.89%	0.69%	8.45%
IWWCB8 6.0	4.44%	95.56%	0.45%	3.89%
IWWCB8 COMP	7.91%	92.09%	1.43%	15.25%
IWWCB9 4.0	2.64%	97.36%	0.68%	3.58%
IWWCB9 COMP	3.17%	96.83%	0.45%	5.24%
IWWCB11 5.0	5.64%	94.36%	1.05%	4.16%
IWWCB11 COMP	3.83%	96.17%	0.61%	11.88%
IWWCB12 4.0	3.78%	96.22%	0.88%	3.74%
IWWCB12 COMP	3.04%	96.96%	0.50%	9.58%
IWWCB13 4.0	3.73%	96.27%	0.56%	2.78%
IWWCB13 COMP	4.63%	95.37%	0.53%	7.84%
IWWCB14 2.0	4.84%	95.16%	5.52%	15.11%
IWWCB14 COMP	2.88%	97.12%	3.74%	14.73%
IWWCB15 6.0	4.83%	95.17%	10.99%	31.44%
IWWCB15 COMP	3.59%	96.41%	11.72%	30.29%
IWWCB16 4.0	2.71%	97.29%	7.63%	18.46%
IWWCB16 COMP	2.76%	97.24%	9.94%	24.84%
IWWCB17 5.0	2.16%	97.84%	8.59%	23.57%
IWWCB17 COMP	2.37%	97.63%	12.56%	37.97%
IWWCB18 5.5	1.65%	98.35%	0.32%	2.53%
IWWCB18 COMP	20.37%	79.63%	3.84%	24.55%
IWWCB19 2.0	6.66%	93.34%	0.63%	4.51%
IWWCB19 COMP	8.16%	91.84%	0.58%	9.70%
IWWCB20 4.0	3.33%	96.67%	0.50%	2.28%
IWWCB20 COMP	3.63%	96.37%	0.55%	5.61%
IWWCB21 COMP	5.54%	94.46%	1.76%	80.19%
IWWCB22 COMP	10.99%	89.01%	4.21%	47.40%
IWWCB23 COMP	3.79%	96.21%	2.36%	49.53%
IWWCB24 COMP	6.74%	93.26%	2.96%	36.62%
IWWCB25 COMP	5.86%	94.14%	2.33%	53.57%

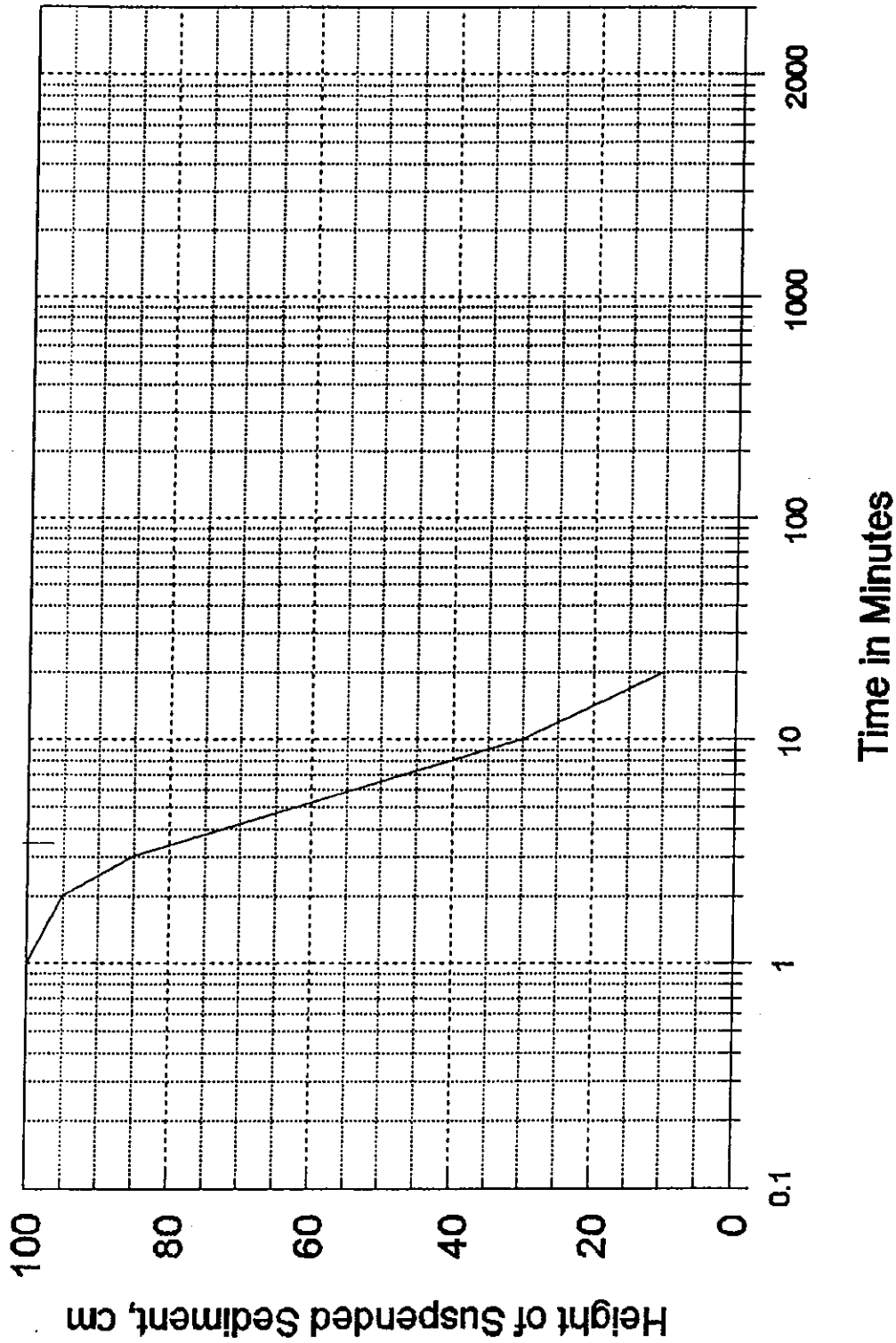
Appendix B

1996 Intracoastal Waterway

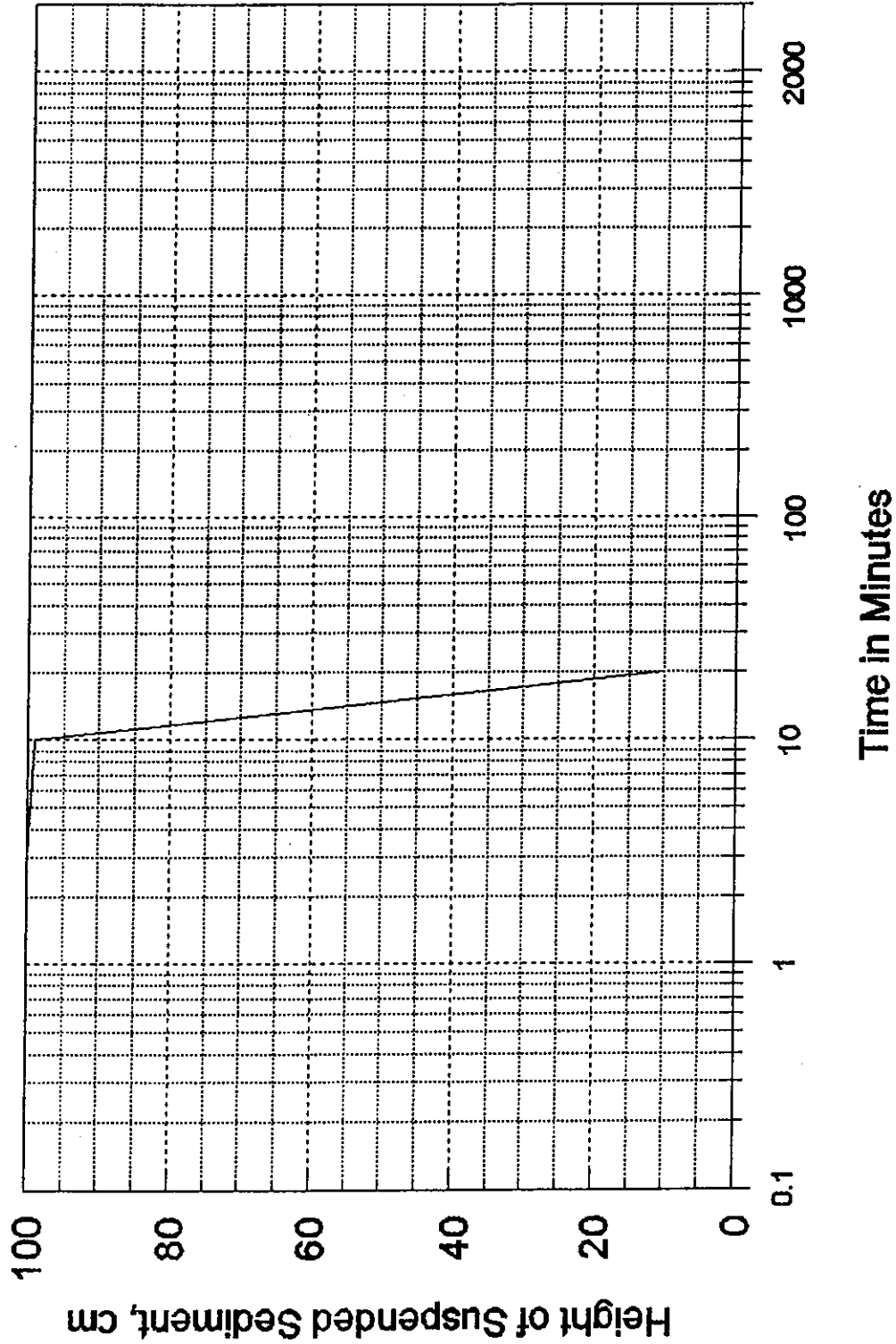
Tests Results of Specific Gravity and Sedimentation Rate

Palm Beach Co. 1996

Core Number	Sample ID	Specific Gravity at 20C
IWWCB 1 4	4.5	2.55
IWWCB1 C	COMP	2.59
IWWCB2	2.5	2.60
IWWCB2 C	COMP	2.51
IWWCB3	1.5	2.55
IWWCB3 C	COMP	2.58
IWWCB4	4.0	2.55
IWWCB4 C	COMP	2.58
IWWCB5	2.5	2.61
IWWCB5 C	COMP	2.57
IWWCB6	3.0	2.54
IWWCB6	COMP	2.56
IWWCB7	1.5	2.59
IWWCB7	3.0	2.56
IWWCB7	6.0	2.57
IWWCB7 C	COMP	2.53
IWWCB8	6.0	2.53
IWWCB8 C	COMP	2.61
IWWCB9	4.0	2.53
IWWCB9 C	COMP	2.51
IWWCB11	5.0	2.51
IWWCB11	COMP	2.52
IWWCB12	COMP	2.52
IWWCB12	4.0	2.60
IWWCB13	4.0	2.56
IWWCB13	COMP	2.56
IWWCB14	2.0	2.63
IWWCB14	COMP	2.59
IWWCB15	6.0	2.55
IWWCB15	COMP	2.61
IWWCB16	4.0	2.53
IWWCB 16	COMP	2.57
IWWCB17	5.0	2.56
IWWCB17	COMP	2.61
IWWCB18	5.5	2.58
IWWCB18	COMP	2.52
IWWCB19	2.0	2.59
IWWCB19	COMP	2.59
IWWCB20	4.0	2.56
IWWCB20	COMP	2.64
IWWCB 21	COMP	2.52
IWWCB25	COMP	2.55



Project	IWW-Palm Beach Harbor		
Area	Palm Beach Harbor - Lake Worth		
Boring Number	IWWCB 1	Sample	4.5
		Elev	-15.4
		Date	October 1996
Suspended Sediment-Time Curve			



Project	IWW-Palm Beach Harbor		
Area	Palm Beach Harbor - Lake Worth		
Boring Number	IWWCB 2	Sample	2.5
		Elev	-14.2
		Date	October 1996
Suspended Sediment-Time Curve			

March 27, 2015

DUNKELBERGER
engineering & testing, inc.

A Terracon COMPANY

Florida Inland Navigation District,
c/o Taylor Engineering, Inc.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300,
Jacksonville, FL 32256

Project No. HD155006

Attention: Ms. Lori S. Brownell, P.E.,
Director, Waterfront Engineering

Subject: **Geotechnical Engineering Report**
Standard Penetration Test Borings
Intracoastal Waterway Deepening Project
Palm Beach County, Florida

Telephone: 904 256-1367

E-mail: LBrownell@Taylorengeering.com

Dear Ms. Brownell:

Dunkelberger Engineering & Testing, A Terracon Company (DUNKELBERGER) has completed subsurface exploration related to the above-referenced project. The work was completed in accordance with our subcontract agreement with Taylor Engineering (Contract No. C2011-068-04) dated January 9, 2015. The following report provides a summary of the project considerations, methods utilized for subsurface exploration, and key findings from the work.

1.0 PROJECT CONSIDERATIONS

The Florida Inland Navigation District (FIND) intends to deepen a portion (approximately 3,500 feet) of the Intracoastal Waterway immediately west of Peanut Island. The project plans currently call for dredging to an elevation of -15 feet Mean Low Water (MLW), with an allowable over-dredge depth of 2 feet (i.e. -17 feet MLW). Review of the Hydrographic Survey for the project provided by Morgan & Eklund, Inc., and dated September 9, 2014, indicates that the existing mudline elevation along the project corridor ranges between approximately -6 and -12 feet MLW.

2.1 SCOPE OF SERVICES

The work consisted of the following elements:

1. Submittal for and acquisition of a permit from the United States Army Corps of Engineers (USACE). The work was completed under USACE permit number SAJ-2012-01719 (NW-AAZ).



Geotechnical Engineering Report

Intracoastal Waterway Deepening Project – Palm Beach County, FL

2. Mark the locations of the borings on the water and implement the Sunshine Utility Clearance process. Locations of the borings were selected based upon the limits of the proposed dredging project (provided by Taylor), information provided in the Morgan & Eklund survey, and in order to be approximately evenly spaced along the alignment of the proposed dredging work. The locations were navigated to utilizing a hand held GPS device. The boring locations were then marked using a painted milk jug (buoy) and rope which was tied to a pair of concrete cinder blocks resting on the mudline.
3. Mobilization of personnel and equipment for the purpose of drilling Standard Penetration Test (SPT) borings in accordance with procedures outlined in ASTM D 1586. A drilling rig mounted on a small barge was mobilized for the work. Upon arrival at each boring location, the barge was fixed horizontally using steel spuds that extended from the deck of the barge to the mudline.
4. SPT Borings – Subsurface exploration was accomplished at four locations.
 - At each location, a single SPT boring was drilled to a depth of 25 feet below the deck of the barge. The time of day was recorded at the beginning and ending of the sampling for each boring.
 - Four inch diameter steel casing was suspended from the deck of the barge and penetrated into the mudline as needed to maintain borehole stability and to enable recirculation of drilling fluids. Upon completion of the drilling operations at each boring location, the steel casing was removed.
 - SPT samples were obtained continuously for each boring at a vertical spacing of 18 inches on center. The samples were classified in the field, placed in sealed glass jars, which were labeled and transported to our laboratory for review by a geotechnical engineer and for laboratory testing.
 - The completed boreholes were sealed with neat cement grout.
 - Drilling mud and soil cuttings were containerized and removed from the project site.
5. Laboratory Testing - Samples obtained from the borings were classified by a geotechnical engineer in accordance with the Unified Soil Classification System (ASTM D 2487) and tested in the laboratory for engineering properties such as moisture and organic content and grain size distribution.
6. Engineering Report – This summary report includes provides a summary of the methods utilized for the subsurface exploration, a boring location plan, subsurface profiles, laboratory test results and key findings from the work.

3.0 BORING LOCATIONS

Boring locations were selected utilizing the limits of the proposed dredging provided by Taylor and information shown on the Morgan & Eklund survey such that they were situated at relatively uniform spacing along the alignment of the channel to be dredged. The following table provides a summary of the boring locations.

Table 1 – Boring Locations

Boring Location	GPS Coordinates	State Plane Coordinates	Station Offset	
TB-1	26°46'48.2"N 80° 02'43.4"W	N 890,391 E 967,618	PB Cut 36	0+50, 40' RT
TB-2	26°46'38.4"N 80° 02'49.8"W	N 889,396 E 967,045	PB Cut 36	12+00, 10' RT
TB-3	26°46'29.8"N 80° 02'56.0"W	N 888,524 E 966,490	PB Cut 36	22+00, 25' RT
TB-4	26°46'18.1"N 80° 02'58.8"W	N 887,340 E 966,245	PB Cut 37	6+00, 25' LT

- Notes: 1. State Plane Coordinates refer to Florida State Plane Coordinate System, East Zone, North American Datum (NAD) 1983.
 2. PB Cut 36 and 37, and Station Offset information refer to locations provided on Morgan & Eklund hydrographic survey.
 3. Locations shown are approximate.

Locations for the borings are provided on Sheet 1 in Appendix A. Typical temporary buoy locations are depicted in the following photographs.



Photograph 1 – Temporary Buoy Location (Viewing North)



Photograph 2 – Temporary Buoy Location (Near Green Marker 39)

4.0 VERTICAL CONTROL

The borings were drilled from the deck of a small barge which was fixed horizontally using steel spuds, but able to float with tidal fluctuations. During the drilling operations, the deck of the barge was used as the reference for the work (i.e. Depth = 0). The water surface was measured to be 1.9 feet below the deck of the barge at each boring location. The time of day at the beginning and ending of the sampling operations for each boring location were recorded. These times were then used together with tide charts to estimate the elevation of the water surface and thus the deck of the barge for each boring location. The work was completed using the vertical datum of Mean Low Water (MLW).

5.1 SUBSURFACE CONDITIONS

Subsurface materials found in the borings generally consisted of gray to brown sands, fine sands with silt, and sands with sand to gravel sized shell and shell fragments to the maximum depth explored. Exceptions to this general profile were found at the locations of TB-1 and TB-3, and are more specifically described as follows:

- TB-1 within the elevation interval of approximately -15.5 to -17 feet MLW, silty fine sands with trace organic matter was found. Organic silt was disclosed next and continued to an elevation of approximately -18.5 feet MLW, and was followed by sandy silt which continues to an approximate elevation of -20.5 feet MLW. The organic silt layer appeared to contain a considerable amount of decayed wooden matter.

Geotechnical Engineering Report

Intracoastal Waterway Deepening Project – Palm Beach County, FL

- TB-3 at an elevation of approximately -16 feet MLW, a formation of cemented sand and shell (Coquina limestone) was found in the profile and continues to the maximum depth explored.

Standard Penetration Tests (SPT's) were completed continuously for the full length of each boring at a vertical spacing of 18 inches. The SPT was accomplished using a 140 pound hammer freely falling a vertical distance of 30 inches to impact the top of the drilling rods and to drive a 2 inch outside diameter split barrel sampler into the subsurface materials. The number of such impact blows required to drive the sampler a vertical distance of 12 inches is recorded as the SPT N value and is used to estimate the relative density of granular materials, the relative consistency of fine grained soils, and the degree of cementation of rock formations. Based upon the results of the SPT's completed for this project, the sands are generally very loose to medium dense, the organic silt and sandy silt materials are soft to very soft, and the Coquina is moderately well cemented to well cemented.

Subsurface profiles for the borings are provided on Sheet 2 within Appendix A.

6.1 LABORATORY TEST RESULTS

Twenty samples of the soils found within the anticipated dredge depth were tested for moisture content and grain size distribution. One sample of the organic silt was tested for moisture content, organic content and grain size distribution. The laboratory testing followed procedures and nomenclature described in the American Society for Testing and Materials (ASTM) including:

- Moisture Content ASTM D 2216
-
- Organic Content ASTM D 2974
-
- Grain Size Distribution ASTM D 422

Moisture and organic contents and amounts passing the US Standard No. 200 Sieve are shown on the subsurface profiles at the appropriate elevations. Grain size distribution curves for the samples tested are provided in Appendix B. The following table provides a summary of the laboratory test results.

Table 2 – Summary of Laboratory Test Results

Soil Type	Moisture Content (%)	Organic Content (%)	Amount Passing Sieve Size (%)		
			No. 4	No. 40	No. 200
SAND	18 - 28	NA	91 - 100	43 - 97	2 - 8
Silty SAND	68	NA	96	76	17
Organic SILT	94	13	99	85	46

7.0 CONCLUSIONS

The results of the subsurface explorations described herein indicate that the proposed channel deepening project is underlain primarily by very loose to medium dense sands and fine sands with silt. However, some areas contain buried deposits of silty sands, organic silts and sandy silts, as indicated by the soils found at Boring TB-1, and by a formation of moderately well cemented to well cemented Coquina limestone as disclosed in Boring TB-3. Note that the organic silts and sandy silts found in Boring TB-1 appeared to contain a significant portion of decaying wooden matter. Our experience with the Coquina limestone formation indicates that it will be significantly more difficult to excavate by dredging when compared with the sandy overburden soils.

8.0 GENERAL COMMENTS

The subsurface information presented in this report is based upon the data obtained from the borings performed at the indicated locations discussed in this report. This report does not reflect variations that may occur across the site, or due to the modifying effects of water currents and/or time. The nature and extent of such variations may not become evident until during dredging. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the information contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.


We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

**Dunkelberger Engineering & Testing,
A Terracon Company**



Kevin E. Aubry, P.E.
Geotechnical Services Manager
FL Registration No. 38475



Jaime Velez, P.E.
Project Geotechnical Engineer
FL Registration No. 66416

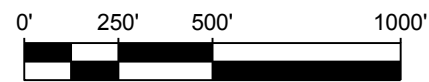
Attachments – Appendix A – Subsurface Exploration
Appendix B – Laboratory Testing

APPENDIX A

SUBSURFACE EXPLORATION



SOURCE: GOOGLE EARTH PRO



LEGEND	
	STANDARD PENETRATION TEST BORING LOCATION AND NUMBER
TB-1	

Locations are approximate.

DRAWN	JJ
CHECKED	DM
APPROVED	KA
SCALE	SEE SCALE BAR
REVISED	

BORING LOCATION PLAN		
INTRACOASTAL WATERWAY DEEPENING PROJECT		
PALM BEACH COUNTY, FLORIDA		
DUNKELBERGER engineering & testing, inc. A Terracon COMPANY		
DATE	E - 28	SHEET
PROJ. NO.		

3-27-15

HD
15
50
06
1

BORING NO.
NORTHING:
EASTING:

TB-1
890391
967618

TB-2
889396
967045

TB-3
888524
966490

TB-4
887340
966245

MLW:

+2.8'

+2.4'

-0.1'

+1.5'

Air

Air

Air

Water

Water

Water

Air

Water

MC=27.5
-200=7.7

Gray fine SAND and fine SAND with silt (SP, SP-SM)

MC=22.7
-200=3.8

Gray fine to coarse SAND with sand sized shell (SP)

MC=24.8
-200=5.9

Gray fine SAND and fine SAND with silt (SP, SP-SM)

MC=67.9
-200=16.8

Gray silty fine SAND, trace organic matter (SM)

MC=93.9
OC=12.7
-200=45.6

Brown organic SILT (OL)

Brown to gray sandy SILT (ML)

Gray SAND (SP)

MC=22.9
-200=6.2

Gray SAND with silt and sand sized shell (SP-SM)

MC=22.1
-200=5.2

MC=21.9
-200=3.6

MC=22.6
-200=3.6

Gray fine SAND (SP)

MC=23.5
-200=2.5

MC=21.7
-200=2.6

Proposed Over-Dredge Bottom
EL -17 Feet MLW

MC=28.1
-200=7.1

Dark gray SAND with silt and sand to gravel sized shell (SP-SM)

MC=25.0
-200=7.8

Gray fine SAND and fine SAND with silt (SP, SP-SM)

MC=24.2
-200=3.5

Gray cemented SAND and SHELL (COQUINA)

MC=21.0
-200=2.6

MC=17.6
-200=4.2

MC=22.9
-200=3.7

MC=23.1
-200=2.6

MC=25.7
-200=2.4

MC=24.9
-200=2.2

Brown to gray SAND with sand to gravel sized shell (SP)

Light brown to gray fine SAND and fine SAND with silt (SP, SP-SM)

Set 4" Diameter Casing
0 - 18"
Time of Sampling: 17:42 to 18:12
Date: March 17, 2015

Set 4" Diameter Casing
0 - 18"
Time of Sampling: 16:48 to 17:15
Date: March 17, 2015

Set 4" Diameter Casing
0 - 15"
Time of Sampling: 12:48 to 13:20
Date: March 17, 2015

Set 4" Diameter Casing
0 - 15"
Time of Sampling: 9:08 to 9:39
Date: March 17, 2015

LEGEND

CO
QUI
NA

SP N

WOH/24 TB-1

AIR

WATER

SAND

SILTY SAND

ORGANIC SILT

SILT

Classification System
Group Symbol (ASTM D
2487)

U
n
i
f
i
e
d
S
o
i
l
C

Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

Indicates sampler advanced 24 inches due to weight of hammer

Standard Penetration Test (SPT) boring and number

-200

MC OC

Amount Finer Than The U.S. Standard No. 200 Sieve (%)

Moisture Content (%) Organic Content (%)

ELEVATION IN FEET (MLW)

ELEVATION IN FEET (MLW)

WATERWAY

DEEPENING PROJECT

PALM BEACH
COUNTY,
FLORIDA

NOTES

- (1) Borings were drilled on
- (2) March 17, 2015 using a barge mounted
- (3) Diedrich Model D-25 drilling rig.

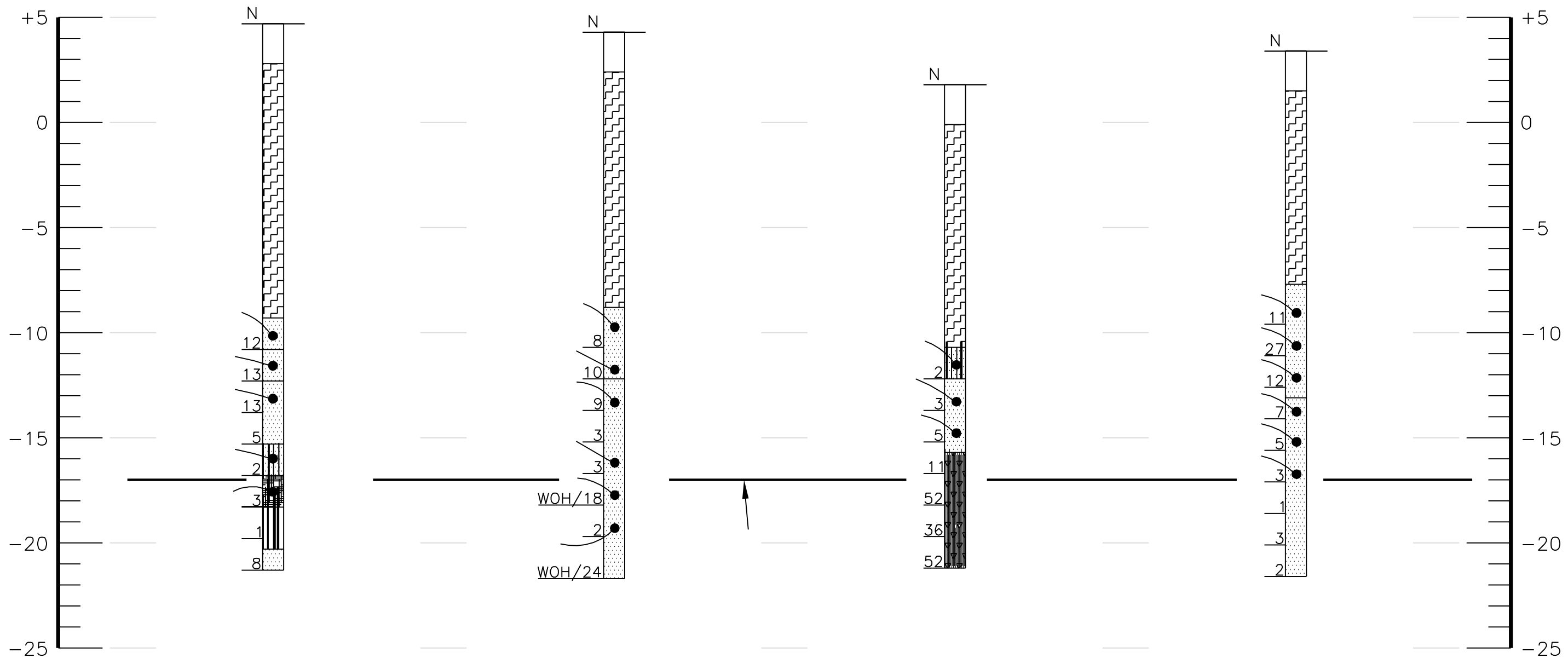
Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

Surface water depths shown on the subsurface profiles represent surface water depths on the dates and times shown. Surface water level fluctuations should be anticipated with the change in tide.

1" = 5'

JJ
DM KA

S
U
B
S
U
R
F
A
C
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P
R
O
F
I
L
E
S
I
N
T
R
A
C
O
A
S
T
A
L

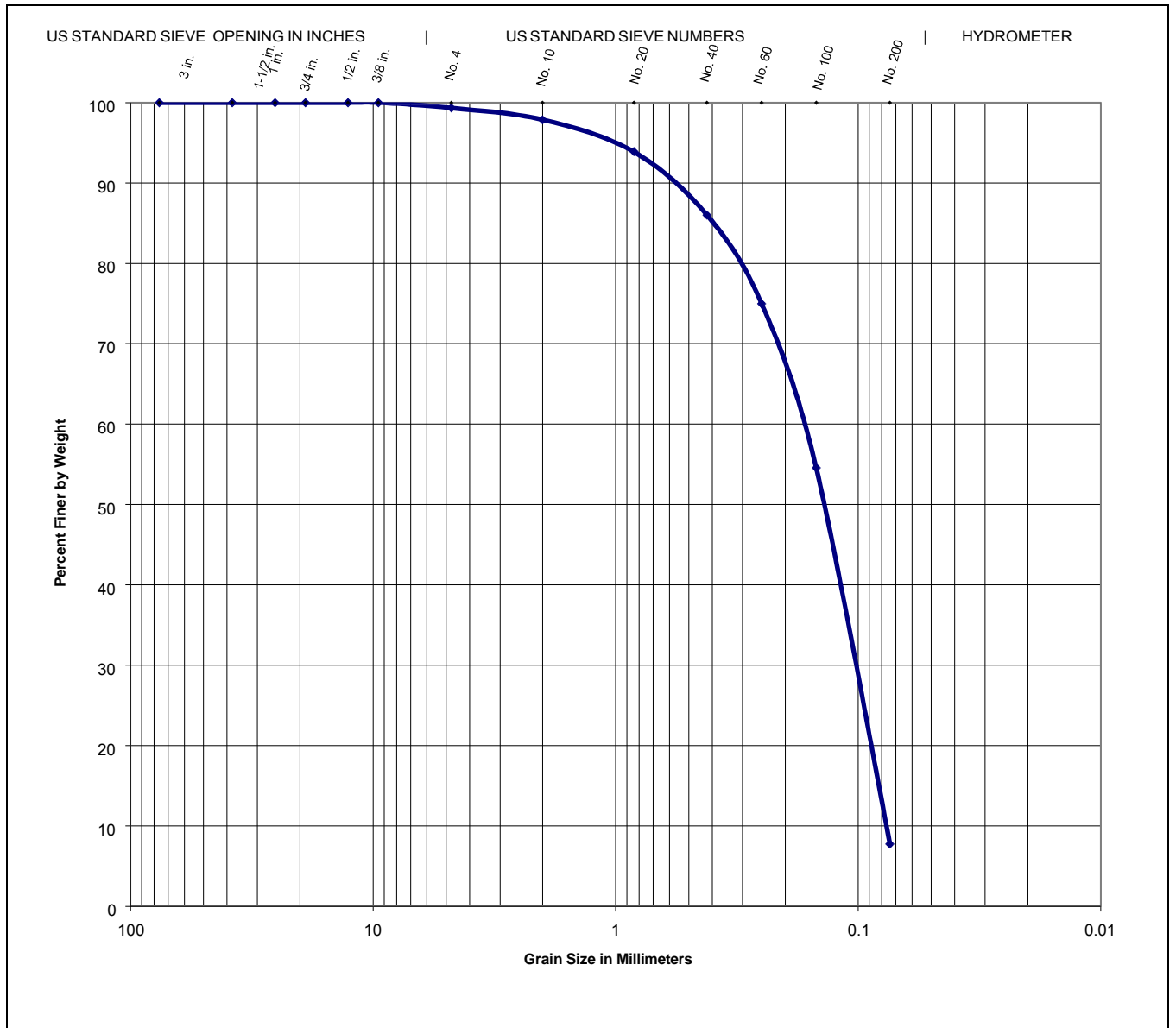


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CHECKED		
APPROVED		
SCALE		
REVISED		
DUNKELBERGER engineering & testing, inc. A Terracon COMPANY		
DATE	PROJ. NO.	SHEET

APPENDIX B

LABORATORY TESTING

Sheet B-1

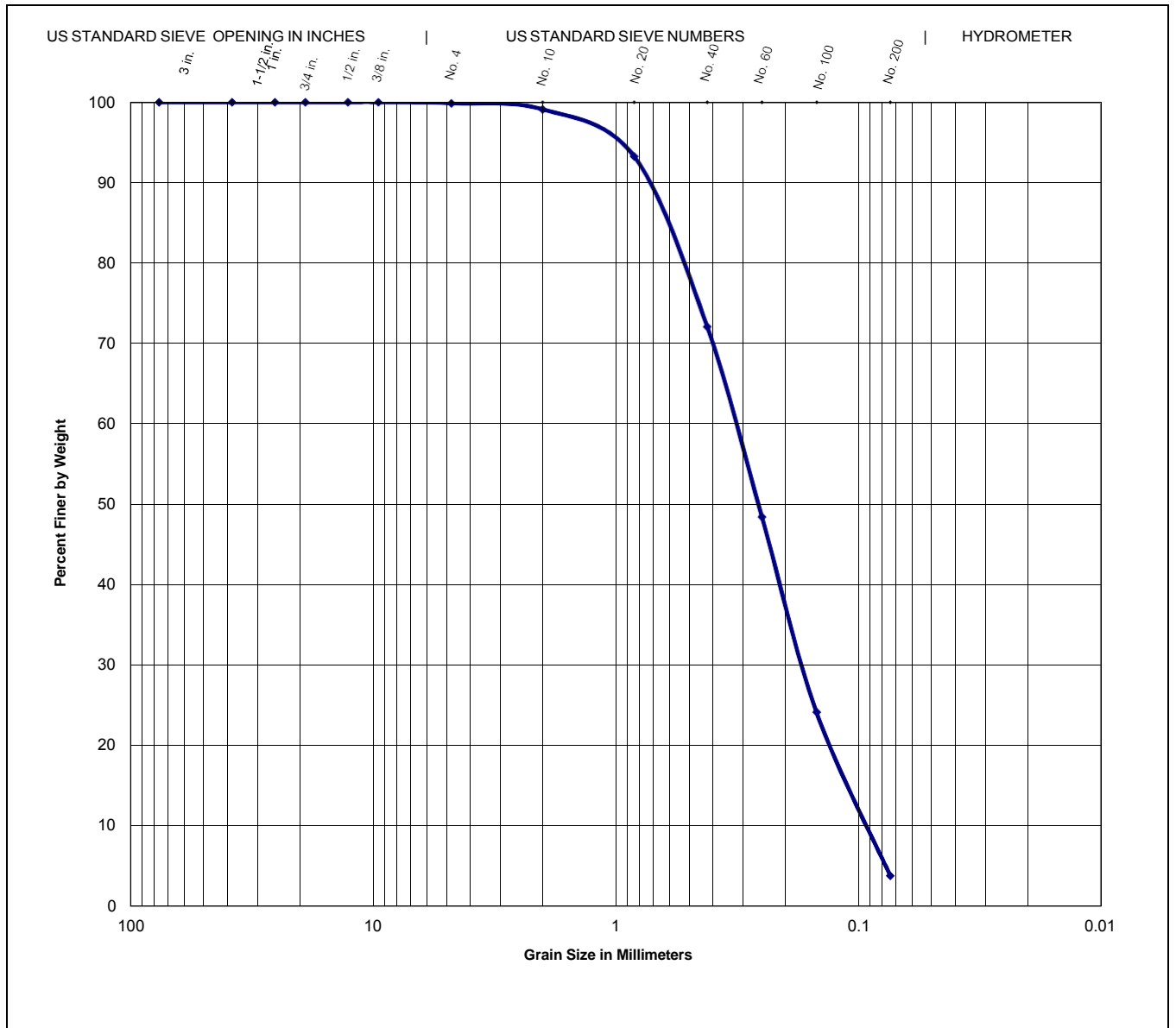


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI																
TB-1, Sample 1	14 ft to 15.5 ft	Gray SAND with silt (SP-SM)	27.5	NA	NA	NA																
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200								
% Passing:		100	100	100	100	100	100	99	98	93.9	86.0	75.0	54.6	7.7								
Eff. Size (D10) =		0.077 mm		Unif. Coef. (D60/ D10) =		2.08		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15														
*NP = Not Plastic																						

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Sheet B-2

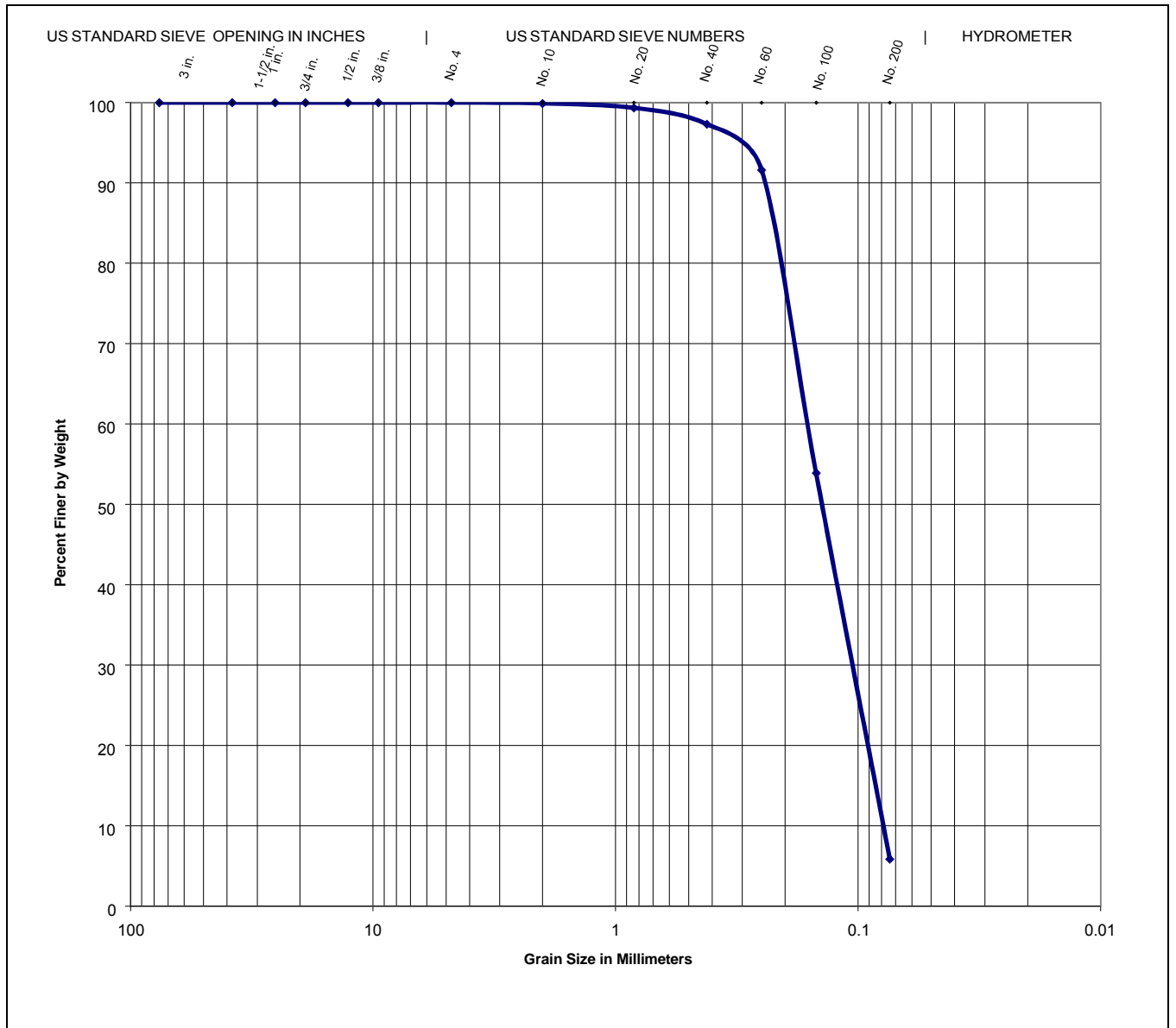


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI			
TB-1, Sample 2	15.5 ft to 17 ft	Gray SAND (SP)											22.7	NA	NA	NA			
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200					
% Passing:		100	100	100	100	100	100	100	99	93.3	72.1	48.4	24.2	3.8					
		Eff. Size (D10) = 0.093 mm		Unif. Coef. (D60/ D10) = 3.33											Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15				
*NP = Not Plastic																			

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Sheet B-3

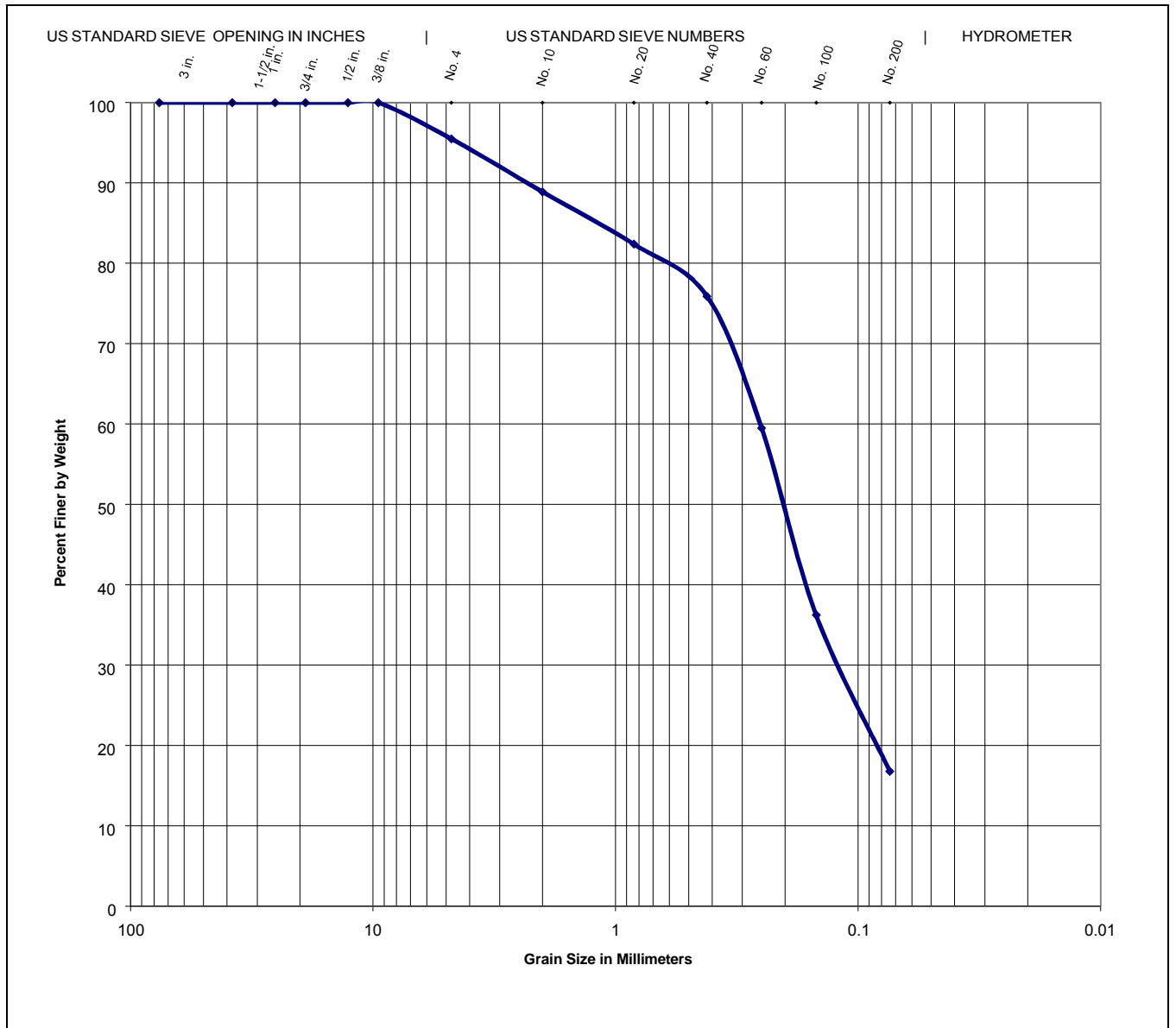


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI			
TB-1, Sample 3	17 ft to 18.5 ft	Gray SAND with silt (SP-SM)											24.8	NA	NA	NA			
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200					
% Passing:		100	100	100	100	100	100	100	100	99.3	97.3	91.6	53.9	5.9					
Eff. Size (D10) =		0.08 mm		Unif. Coef. (D60/ D10) = 2.13											Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15				
*NP = Not Plastic																			

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Sheet B-4

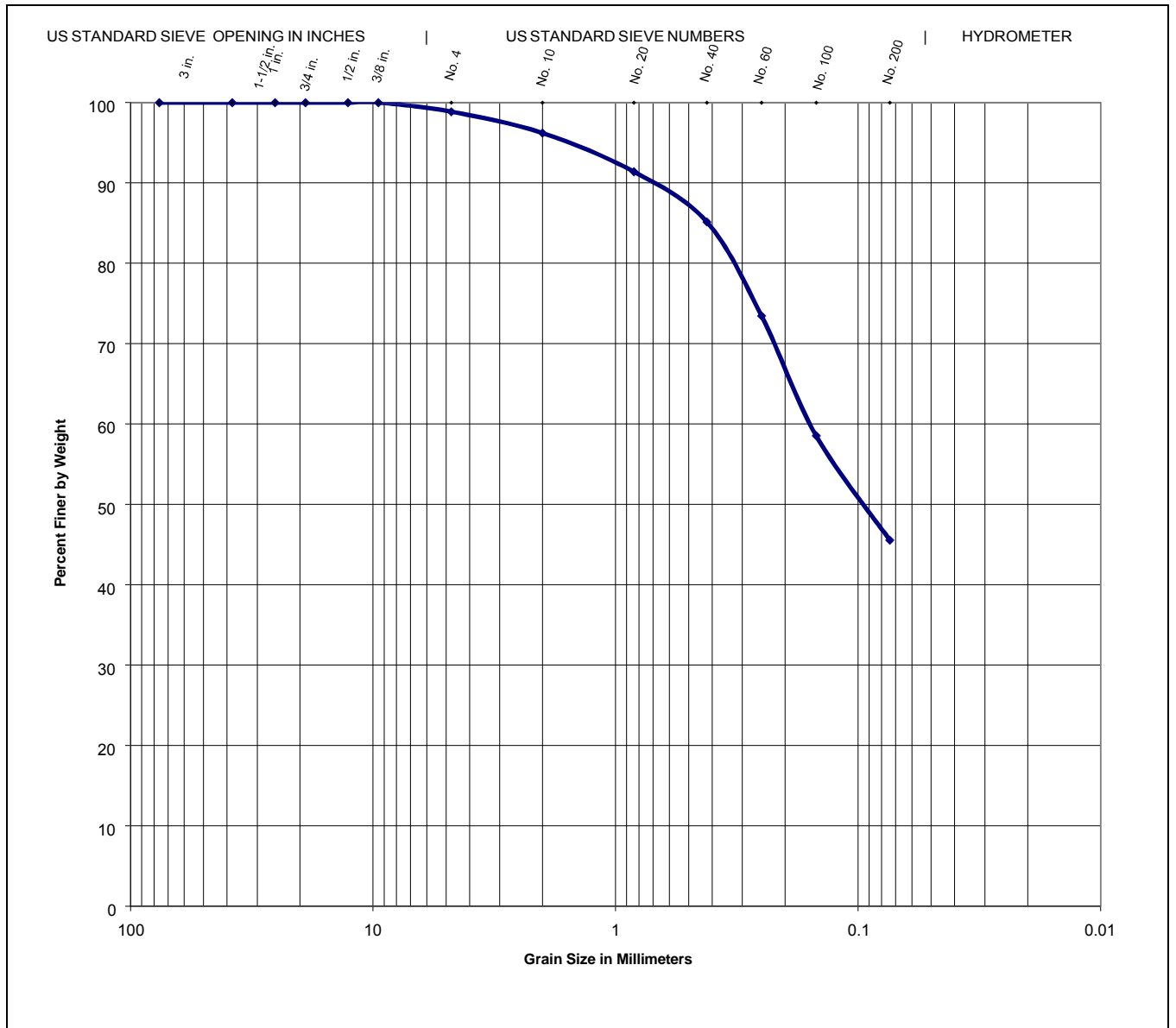


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI											
TB-1, Sample 5	20 ft to 21.5 ft	Gray silty SAND (SM)											67.9	NA	NA	NA											
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200													
% Passing:		100	100	100	100	100	100	95	89	82.4	75.9	59.5	36.2	16.8													
Eff. Size (D10) = N/A				Unif. Coef. (D60/D10) = N/A				Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15																			
*NP = Not Plastic																											

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Sheet B-5

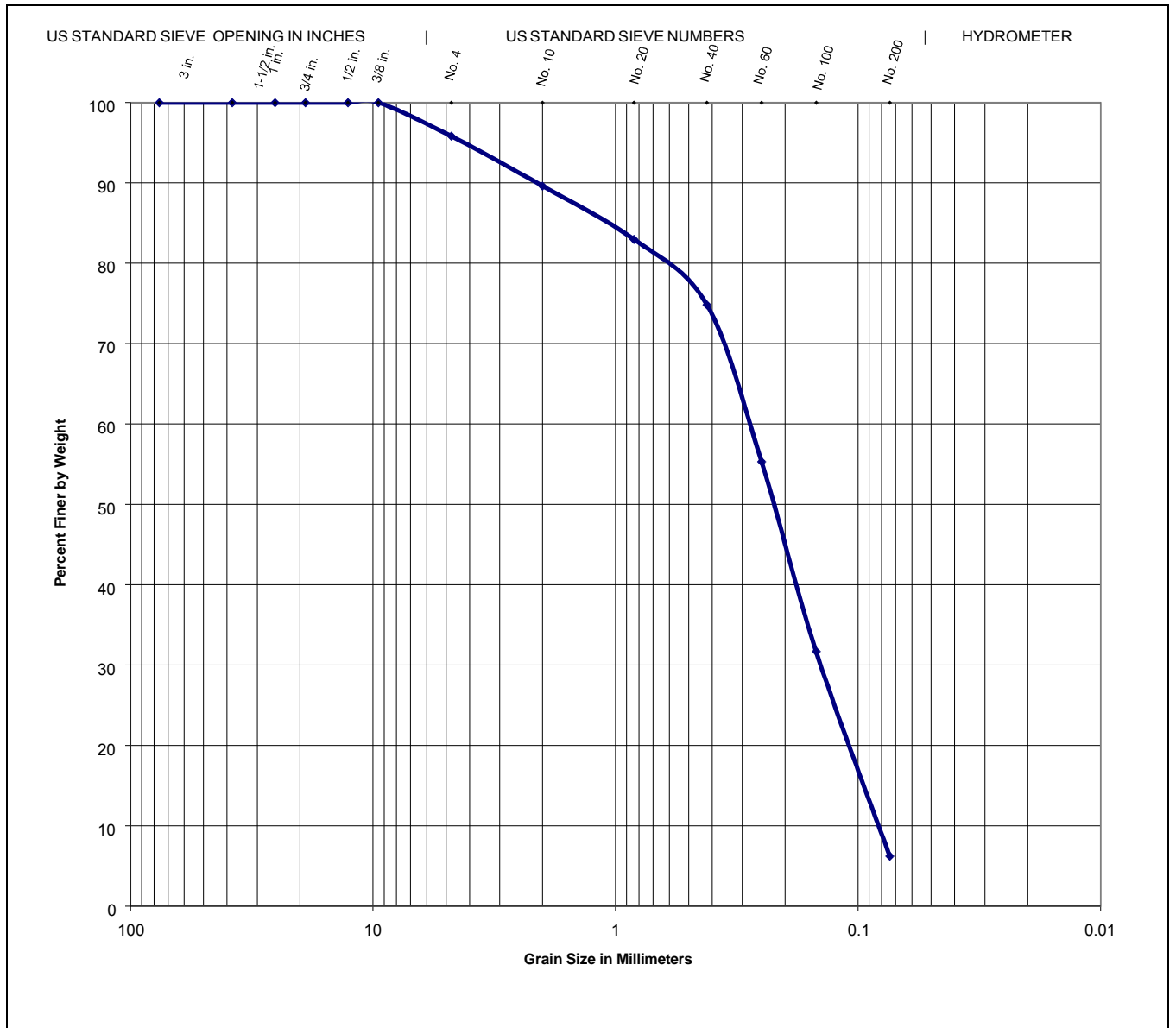


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION												W%	LL	PL	PI		
TB-1, Sample 6	21.5 ft to 23 ft	Brown organic silty SAND (SM)												93.9	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200					
% Passing:		100	100	100	100	100	100	99	96	91.4	85.1	73.5	58.5	45.6					
Eff. Size (D10) =		N/A		Unif. Coef. (D60/ D10) =												N/A			
Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15															*NP = Not Plastic				

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Sheet B-6

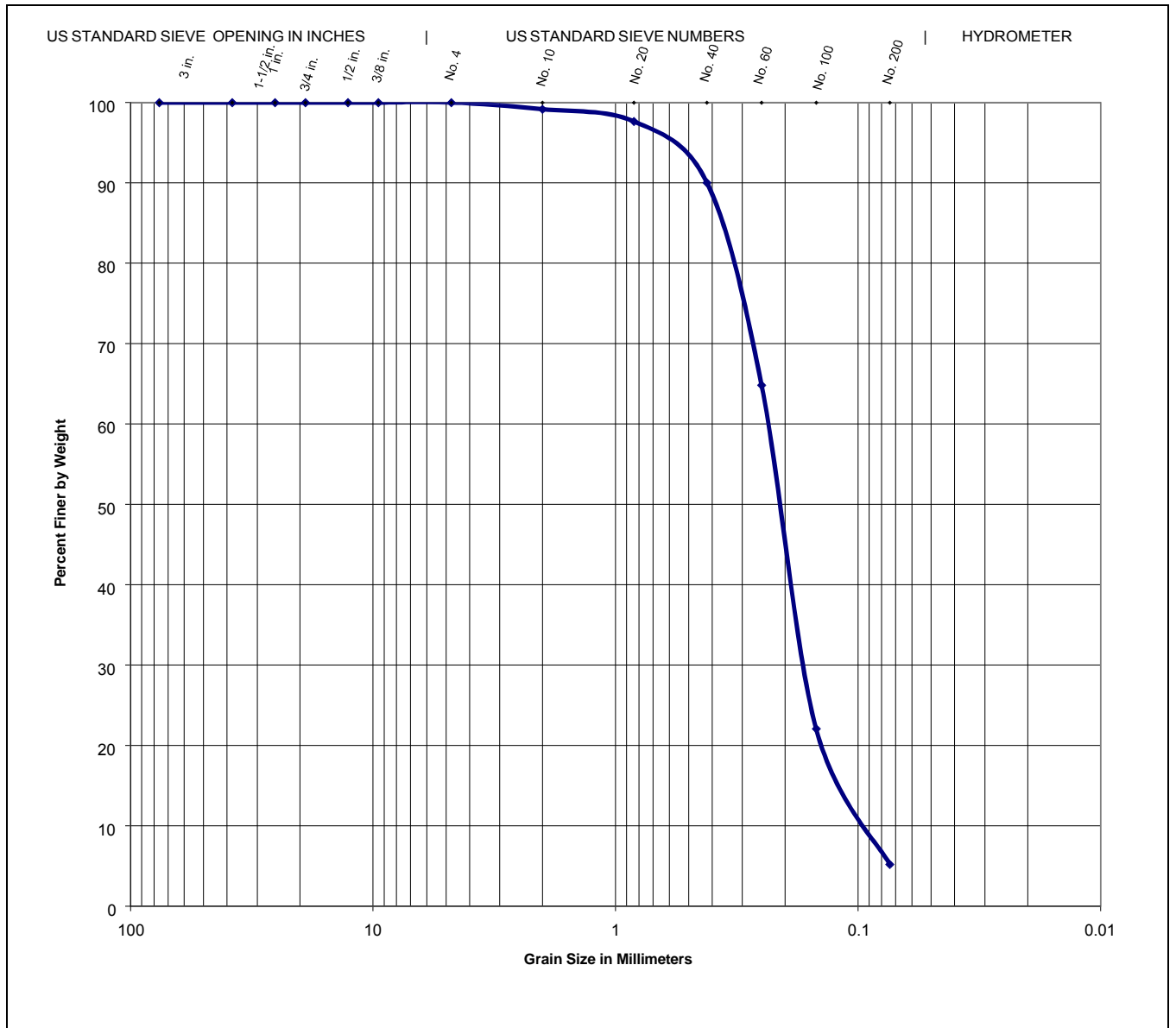


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION										W%	LL	PL	PI		
TB-2, Sample 1	13.5 ft to 15 ft	Gray SAND with silt (SP-SM)										22.9	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200			
% Passing:		100	100	100	100	100	100	96	90	83.0	74.8	55.3	31.7	6.2			
Eff. Size (D10) =		0.083 mm		Unif. Coef. (D60/ D10) = 3.49										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15			
*NP = Not Plastic																	

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Sheet B-7

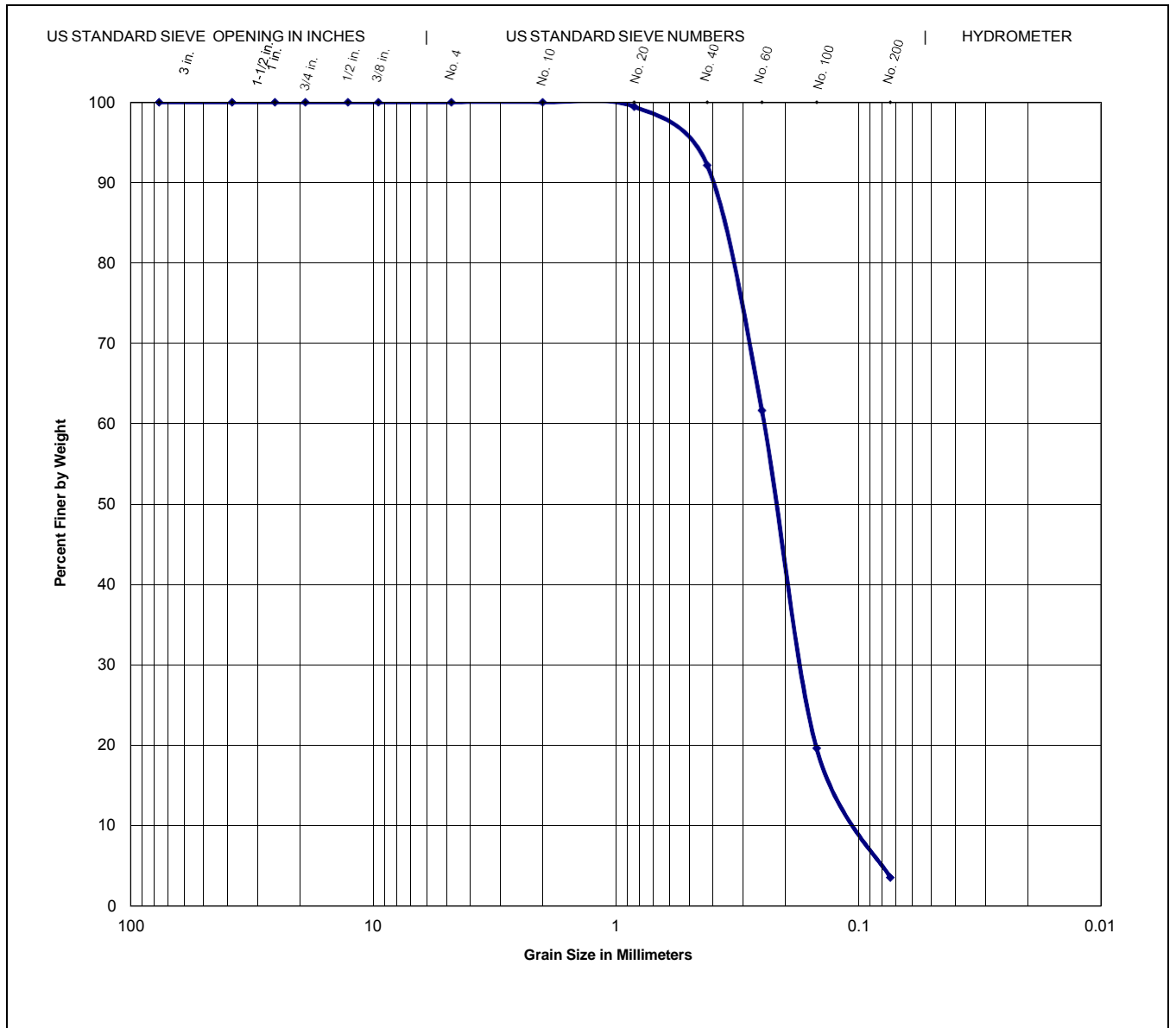


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION										W%	LL	PL	PI		
TB-2, Sample 2	15 ft to 16.5 ft	Gray SAND with silt (SP-SM)										22.1	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200			
% Passing:		100	100	100	100	100	100	100	99	97.7	90.0	64.8	22.1	5.2			
Eff. Size (D10) =		0.098 mm		Unif. Coef. (D60/ D10) = 2.24										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15			
*NP = Not Plastic																	

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Sheet B-8

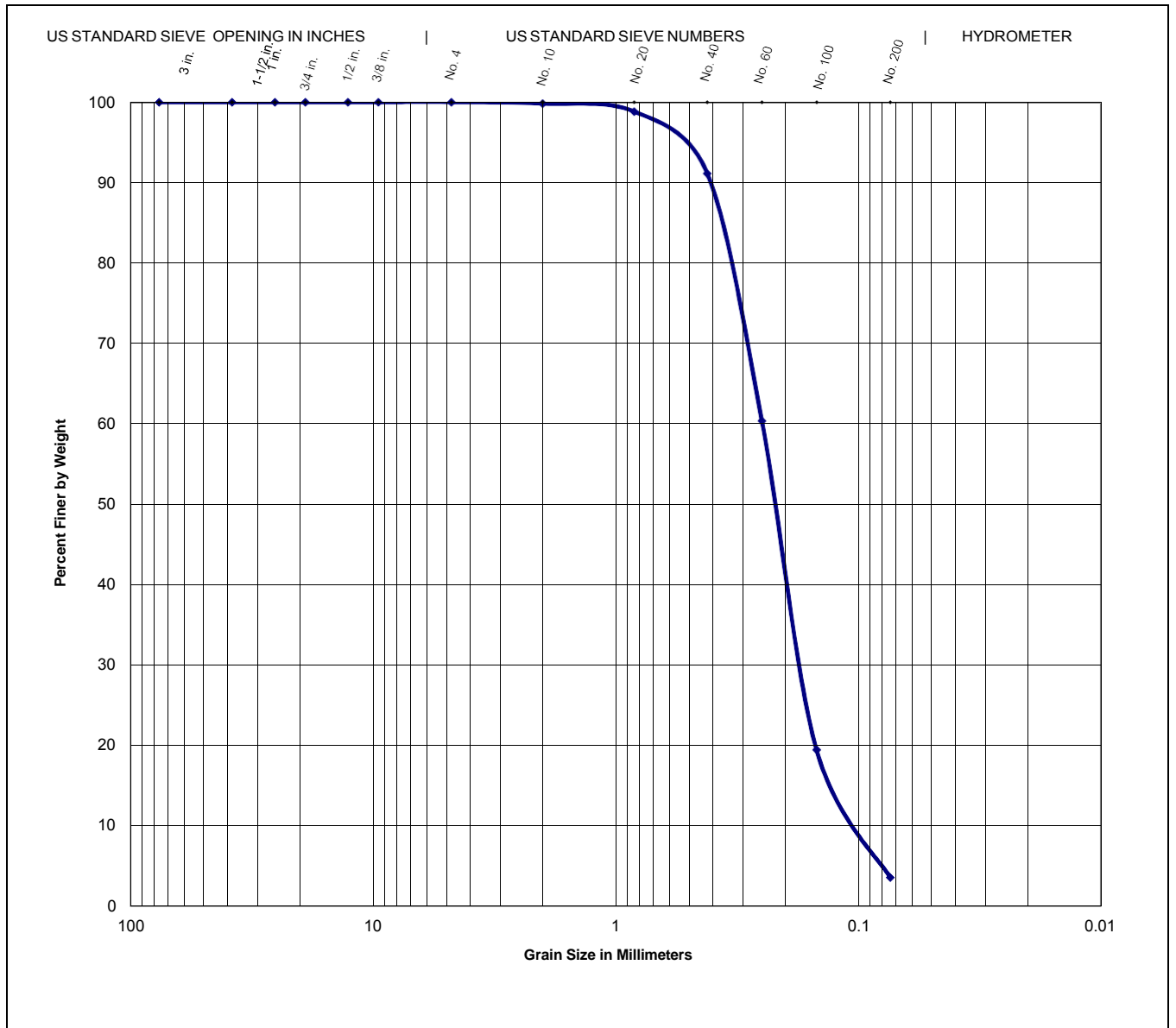


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI								
TB-2, Sample 3	16.5 ft to 18 ft	Gray SAND (SP)	21.9	NA	NA	NA								
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200
% Passing:		100	100	100	100	100	100	100	100	99.4	92.2	61.7	19.7	3.6
Eff. Size (D10) =		0.11 mm		Unif. Coef. (D60/ D10) =		2.18		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15						
*NP = Not Plastic														

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Sheet B-9

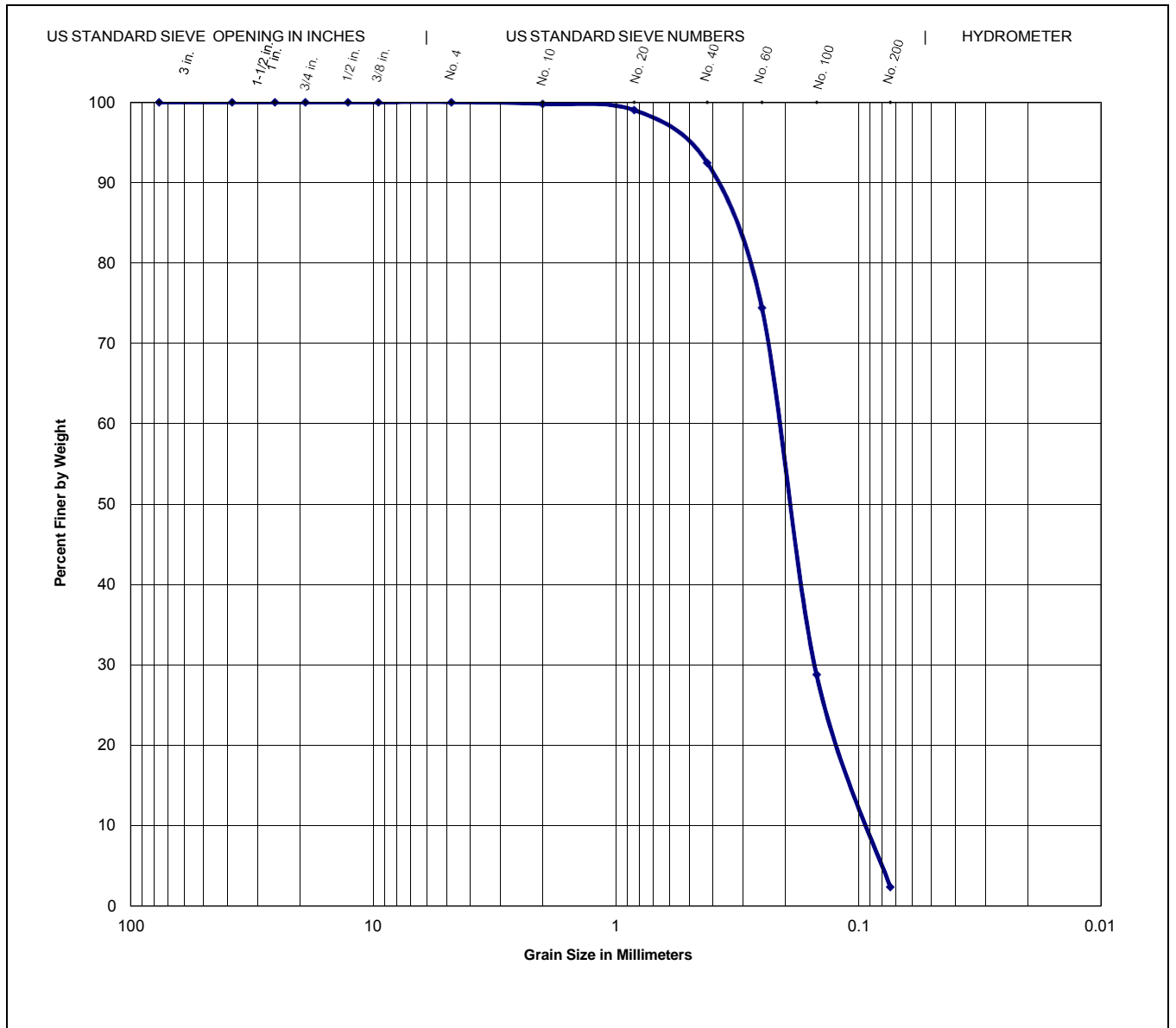


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI								
TB-2, Sample 4	18 ft to 19.5 ft	Gray SAND (SP)	22.6	NA	NA	NA								
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200
% Passing:		100	100	100	100	100	100	100	100	98.8	91.1	60.4	19.5	3.6
Eff. Size (D10) =		0.11 mm		Unif. Coef. (D60/ D10) =		2.27		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15						
*NP = Not Plastic														

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Sheet B-10

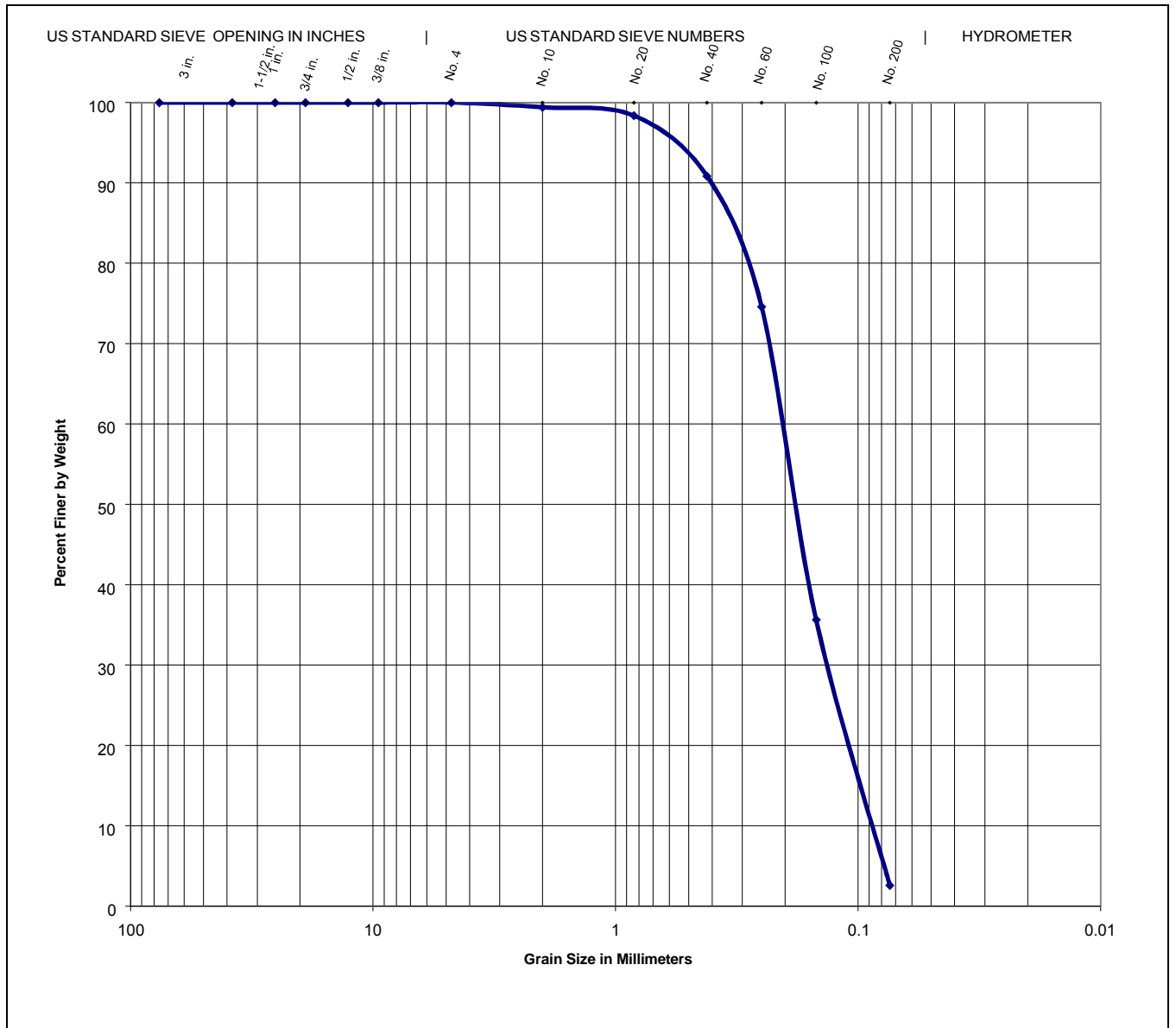


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI		
TB-2, Sample 5	19.5 ft to 21 ft	Gray SAND (SP)											23.5	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200				
% Passing:		100	100	100	100	100	100	100	100	99.0	92.5	74.4	28.9	2.5				
		Eff. Size (D10) = 0.093 mm		Unif. Coef. (D60/ D10) = 2.26														
		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL																
		Project Number : HD155006																
		Date : 3/25/15																
*NP = Not Plastic																		

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Sheet B-11

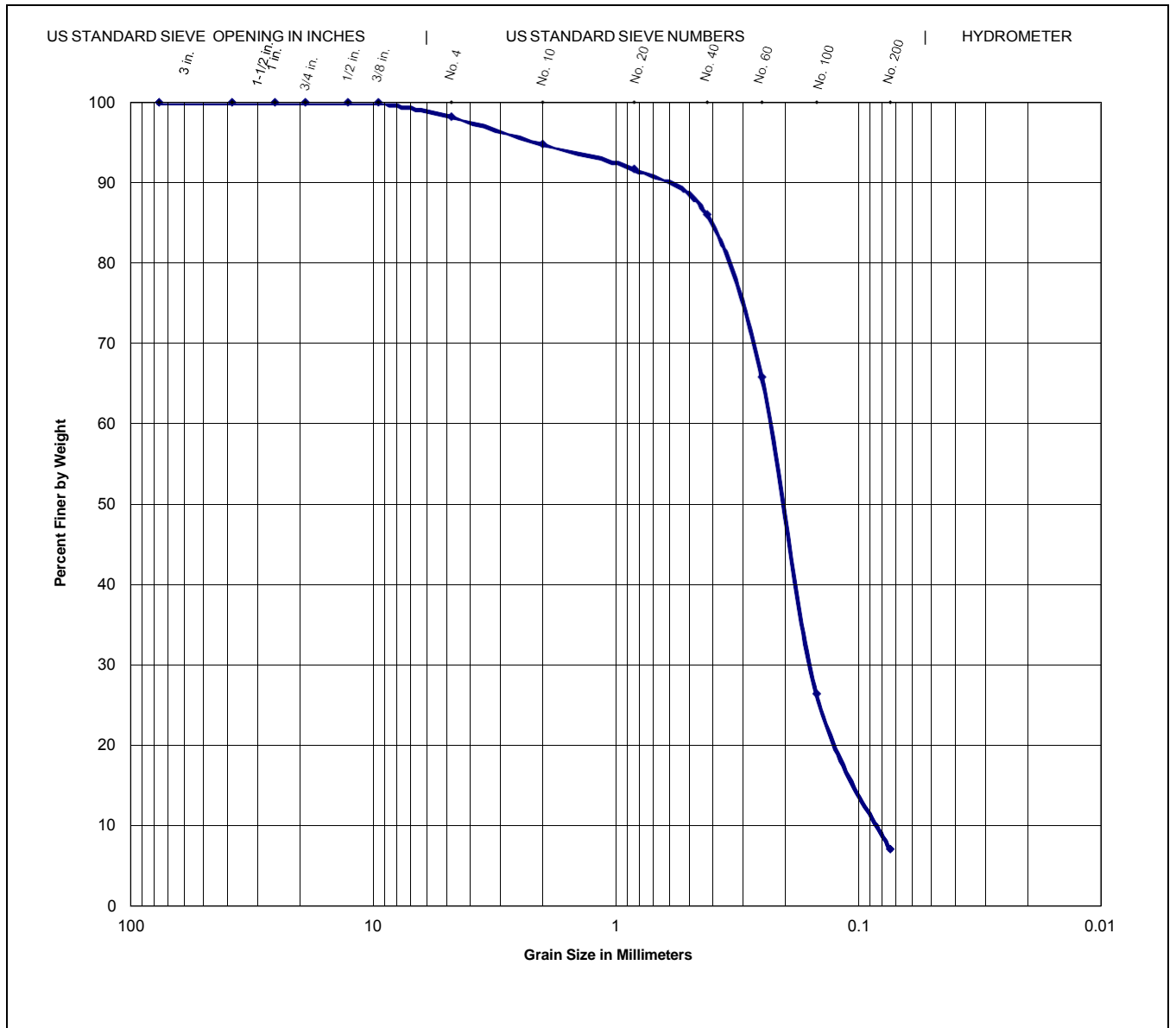


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI																
TB-2, Sample 6	21 ft to 22.5 ft	Gray SAND (SP)	21.7	NA	NA	NA																
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200								
% Passing:		100	100	100	100	100	100	100	99	98.4	90.9	74.6	35.7	2.6								
Eff. Size (D10) =		0.09 mm		Unif. Coef. (D60/ D10) =		2.22		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15														
*NP = Not Plastic																						

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Sheet B-12

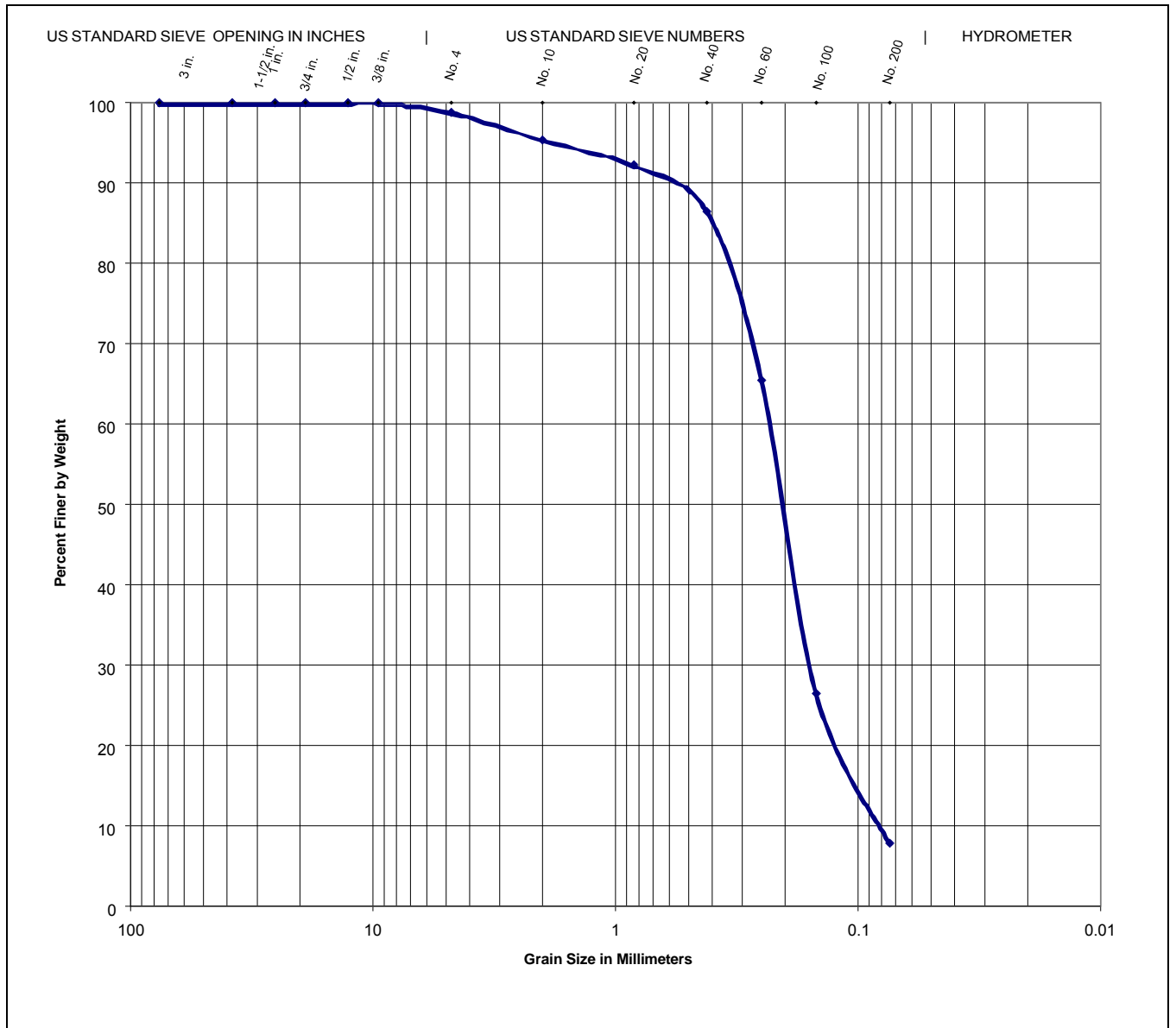


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI			
TB-3, Sample 1	12.5 ft to 14 ft	Gray SAND with silt (SP-SM)											28.1	NA	NA	NA			
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200					
% Passing:		100	100	100	100	100	100	98	95	91.7	86.0	65.8	26.5	7.1					
Eff. Size (D10) =		0.085 mm		Unif. Coef. (D60/ D10) = 2.71											Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15				
*NP = Not Plastic																			

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Sheet B-13

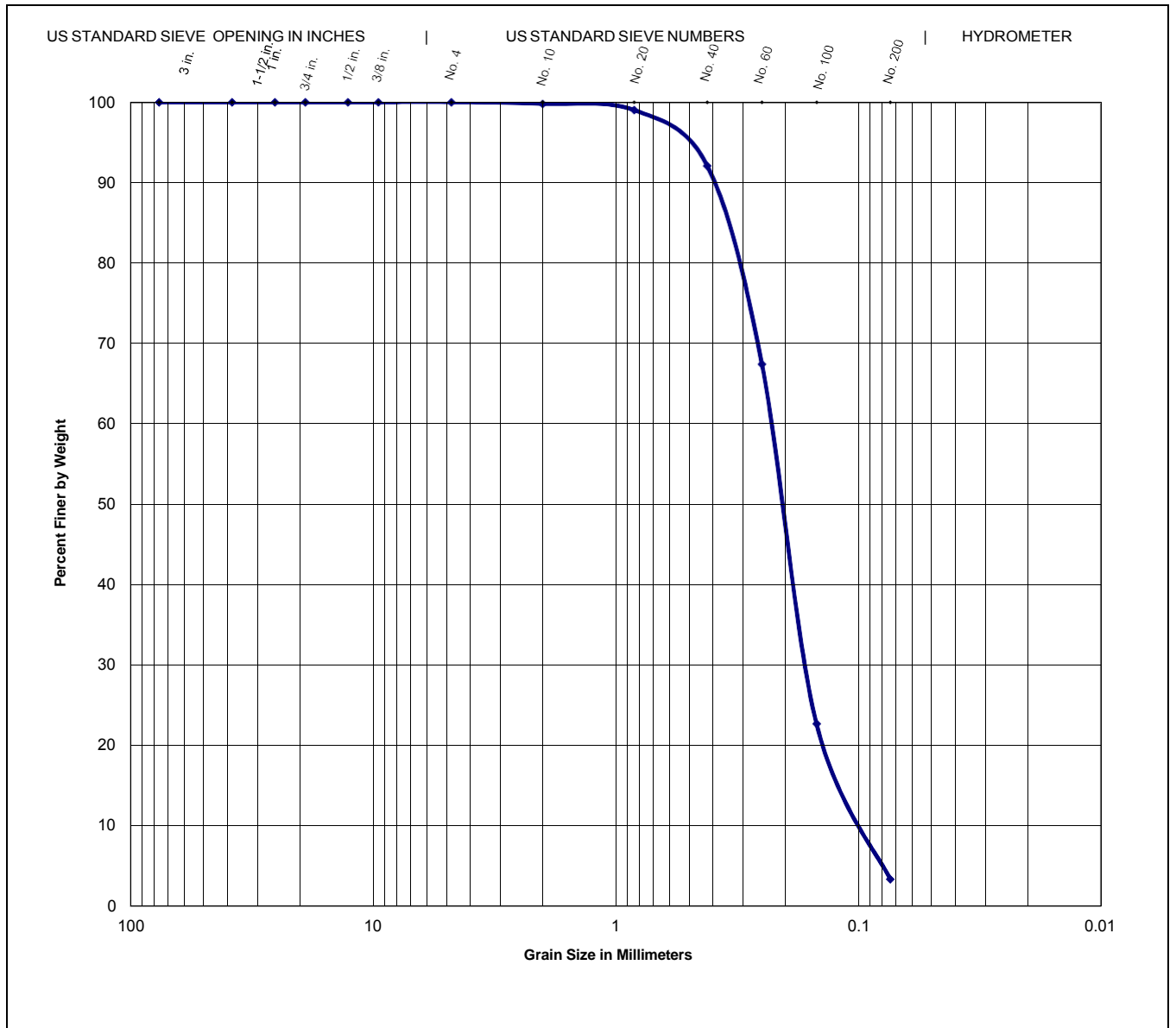


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION										W%	LL	PL	PI		
TB-3, Sample 2	14 ft to 15.5 ft	Gray SAND with silt (SP-SM)										25.0	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200			
% Passing:		100	100	100	100	100	100	99	95	92.2	86.5	65.5	26.5	7.8			
Eff. Size (D10) =		0.08 mm		Unif. Coef. (D60/ D10) = 2.88										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15			
*NP = Not Plastic																	

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Sheet B-14

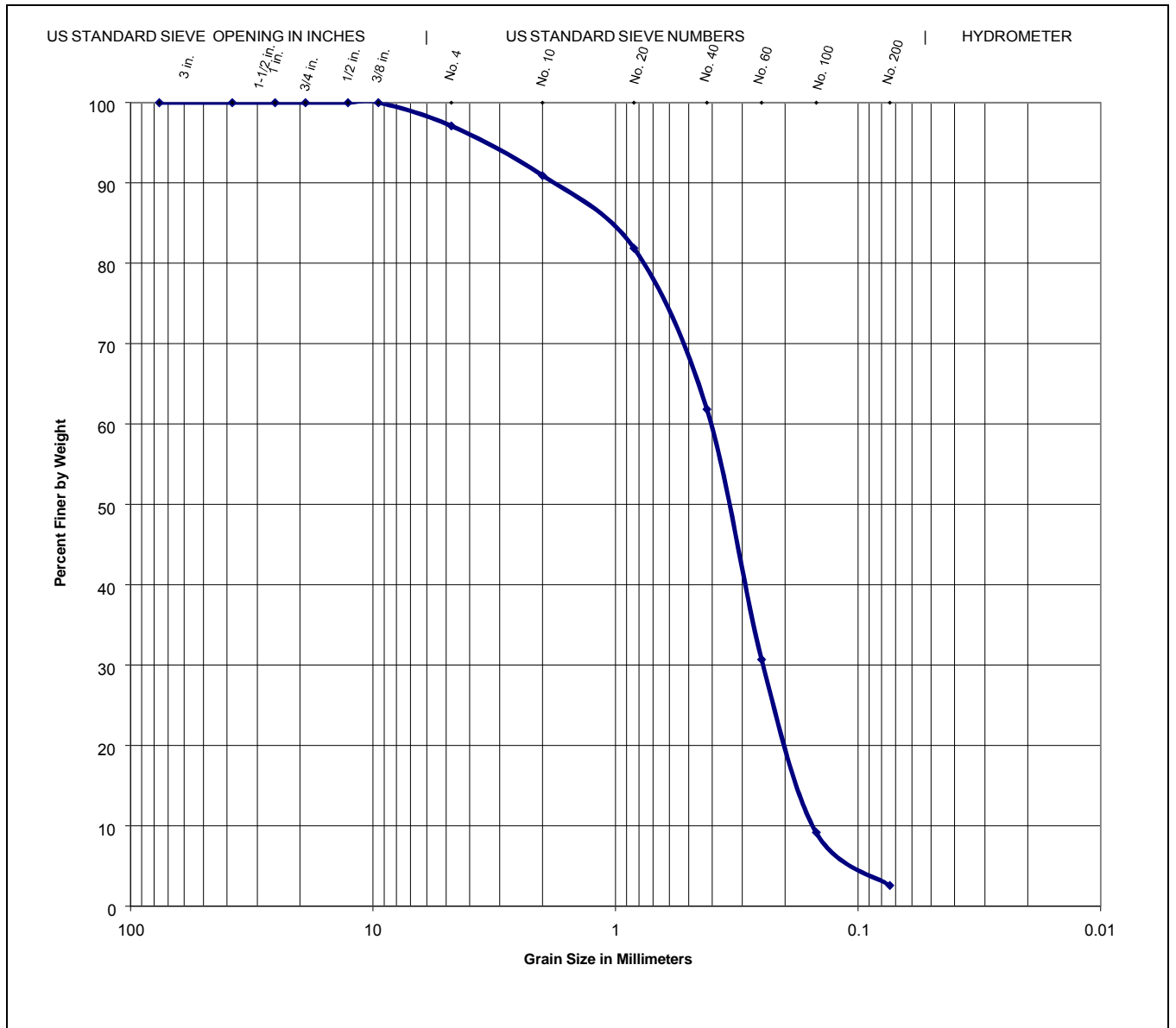


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION												W%	LL	PL	PI		
TB-3, Sample 3	15.5 ft to 17 ft	Gray SAND (SP)												24.2	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200					
% Passing:		100	100	100	100	100	100	100	100	99.0	92.1	67.5	22.8	3.5					
		Eff. Size (D10) = 0.1 mm		Unif. Coef. (D60/ D10) = 2.20										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15					
*NP = Not Plastic																			

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Sheet B-15

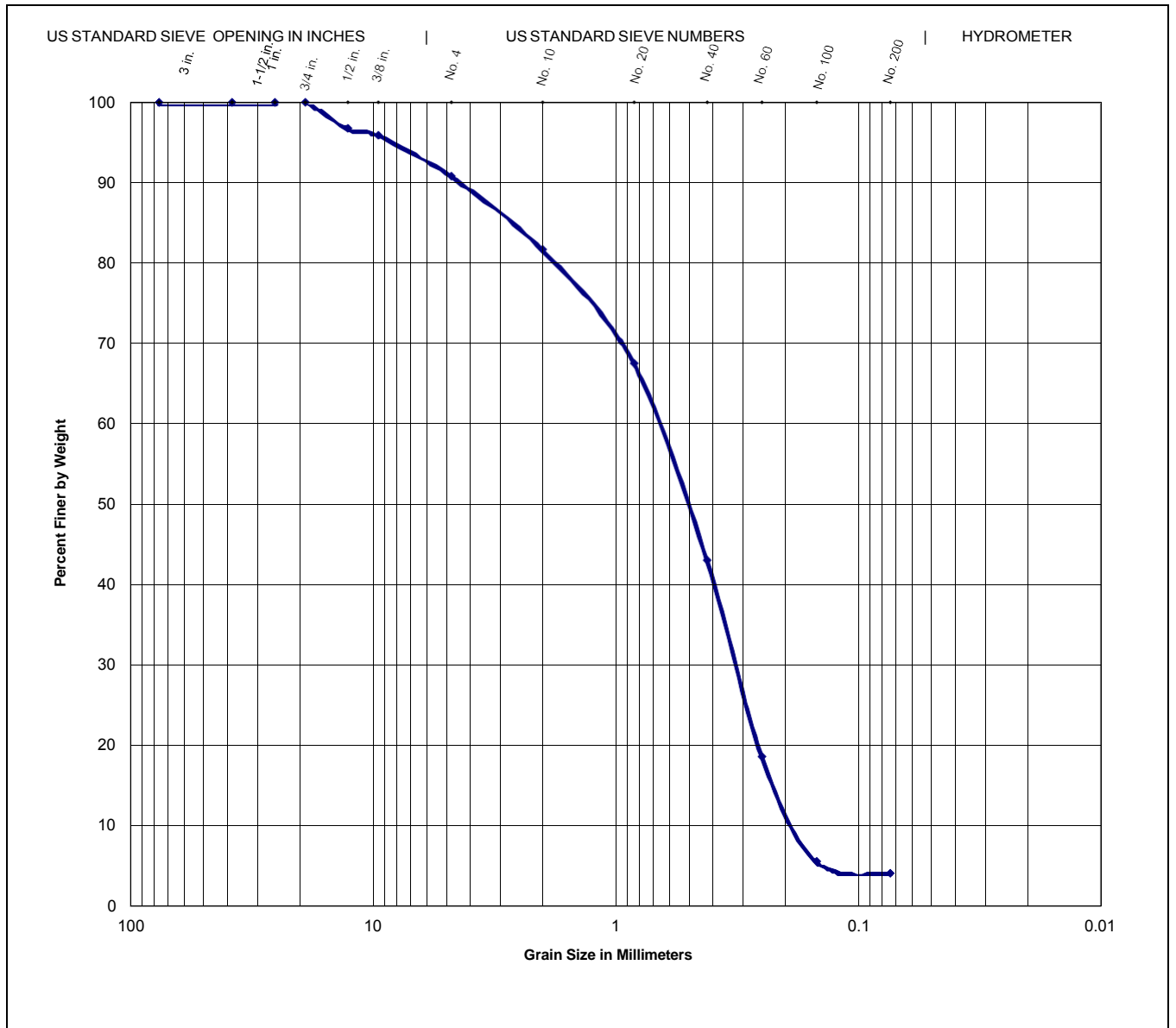


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION											W%	LL	PL	PI				
TB-4, Sample 1	11.5 ft to 13 ft	Brown to gray SAND (SP)											21.0	NA	NA	NA				
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200						
% Passing:		100	100	100	100	100	100	97	91	81.9	61.8	30.7	9.2	2.6						
Eff. Size (D10) =		0.15 mm		Unif. Coef. (D60/ D10) = 2.67											Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15					
*NP = Not Plastic																				

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Sheet B-16

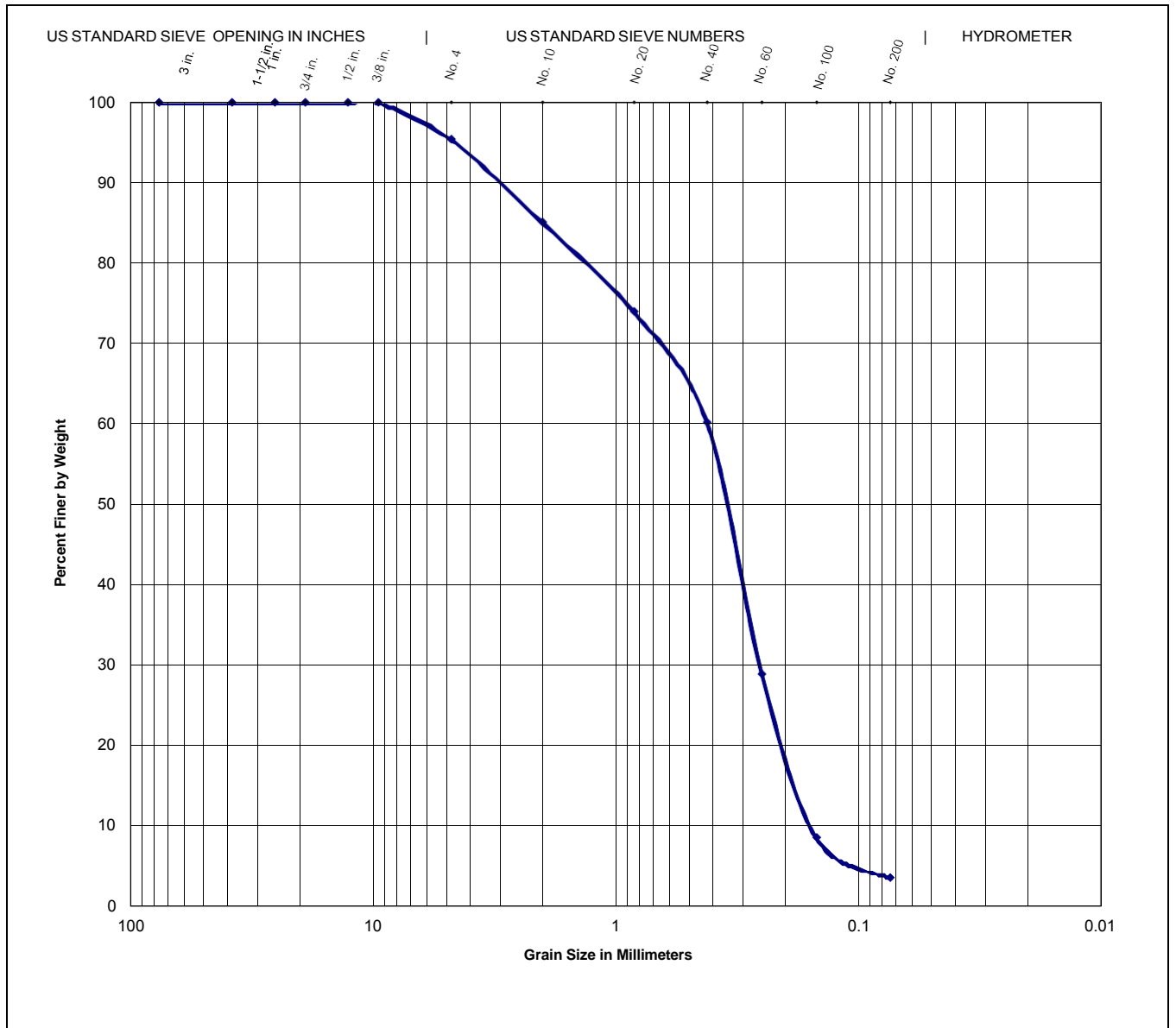


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI																
TB-4, Sample 2	13 ft to 14.5 ft	Brown to gray SAND (SP)	17.6	NA	NA	NA																
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200								
% Passing:		100	100	100	100	97	96	91	82	67.6	43.1	18.7	5.6	4.2								
Eff. Size (D10) =		0.19 mm		Unif. Coef. (D60/ D10) =		3.42		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15														
*NP = Not Plastic																						

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Sheet B-17

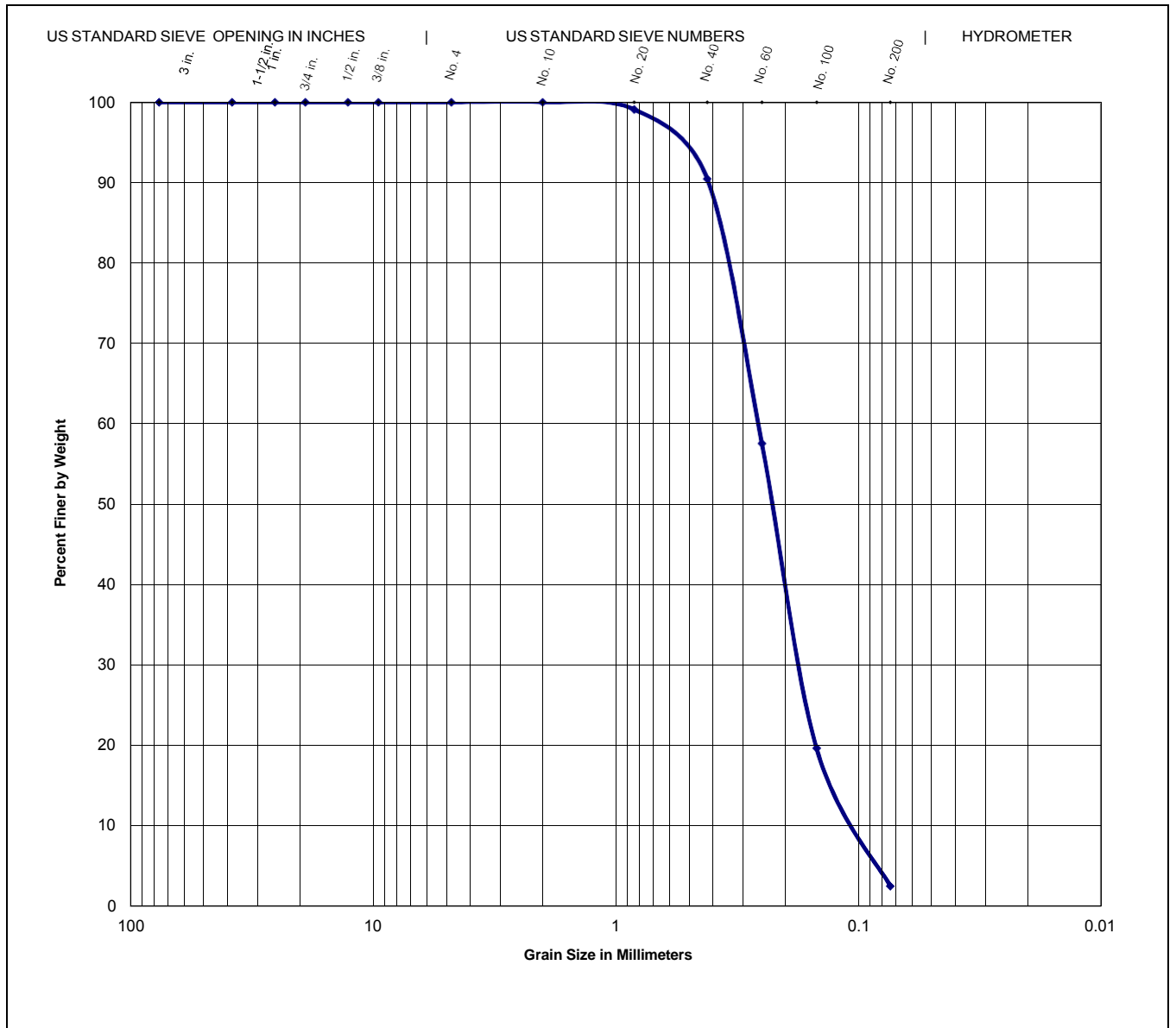


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION										W%	LL	PL	PI		
TB-4, Sample 3	14.5 ft to 16 ft	Brown to gray SAND (SP)										22.9	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200			
% Passing:		100	100	100	100	100	100	95	85	74.0	60.2	29.0	8.6	3.7			
Eff. Size (D10) =		0.17 mm		Unif. Coef. (D60/ D10) = 2.47										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15			
*NP = Not Plastic																	

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Sheet B-18

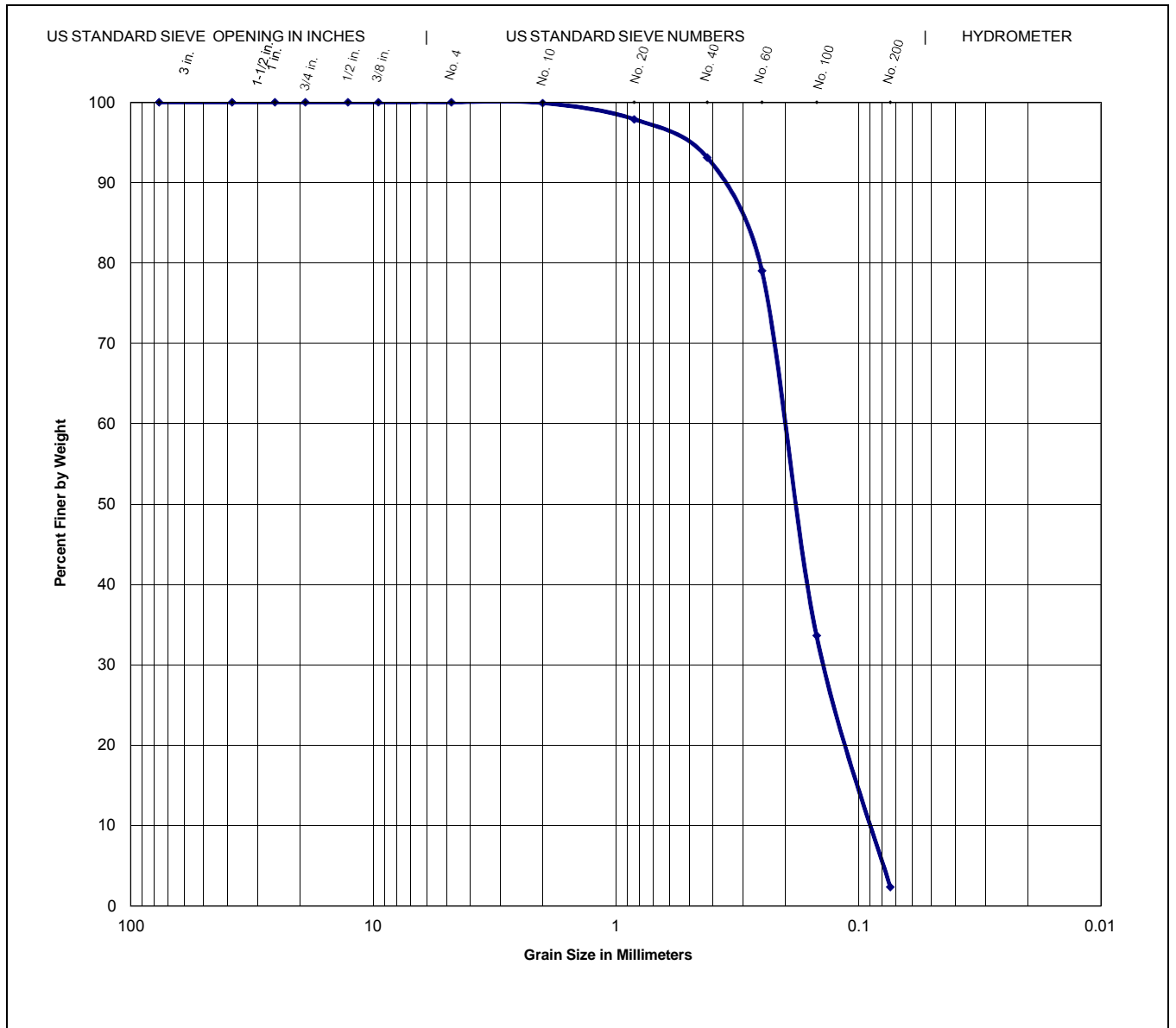


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI								
TB-4, Sample 4	16 ft to 17.5 ft	Brown to gray SAND (SP)	23.1	NA	NA	NA								
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200
% Passing:		100	100	100	100	100	100	100	100	99.1	90.5	57.6	19.7	2.6
Eff. Size (D10) =		0.11 mm		Unif. Coef. (D60/ D10) =		2.36		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15						
*NP = Not Plastic														

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Sheet B-19

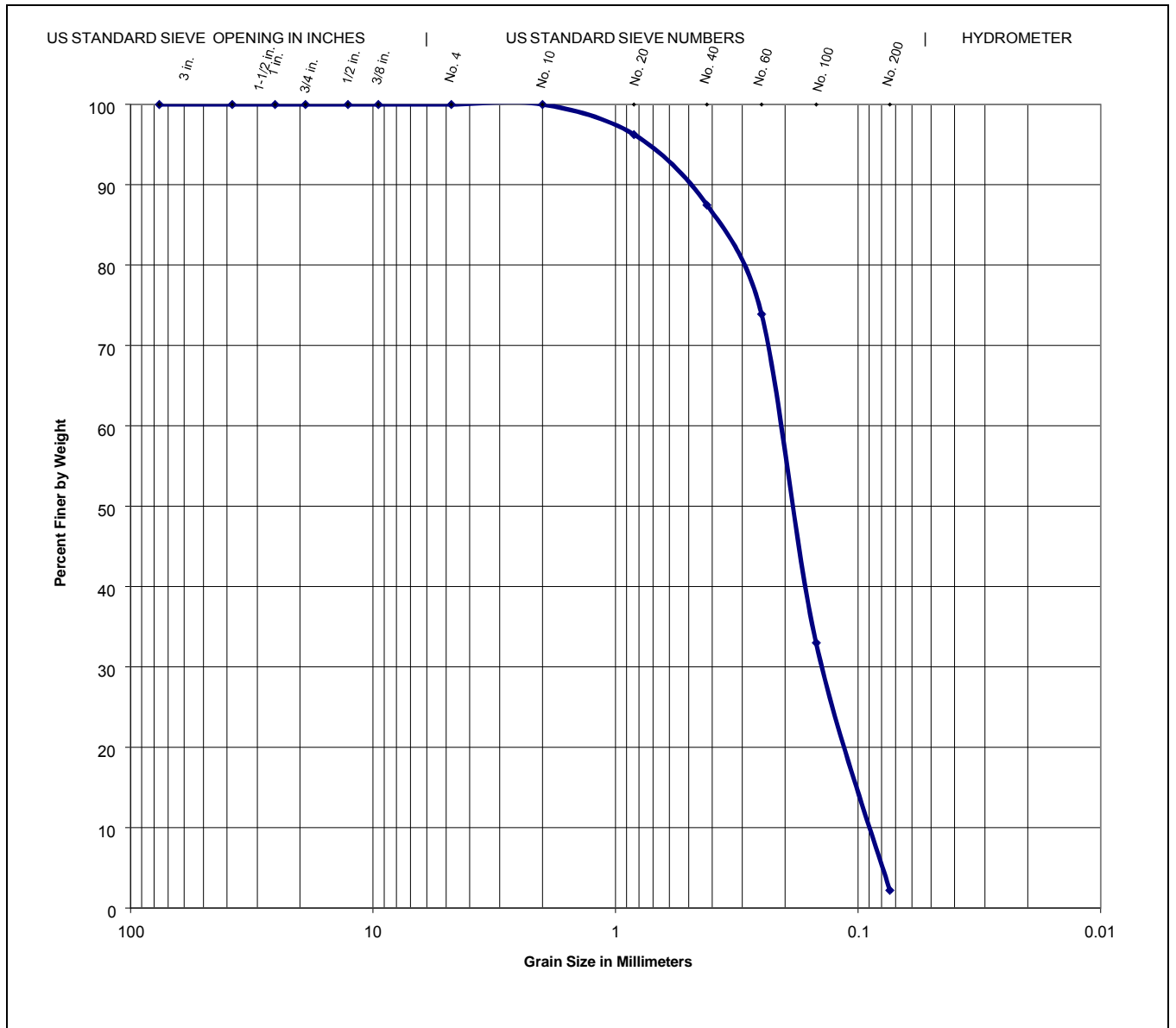


GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION										W%	LL	PL	PI		
TB-4, Sample 5	17.5 ft to 19 ft	Brown to gray SAND (SP)										25.7	NA	NA	NA		
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200			
% Passing:		100	100	100	100	100	100	100	100	97.9	93.1	79.0	33.7	2.4			
Eff. Size (D10) =		0.09 mm		Unif. Coef. (D60/ D10) = 2.22										Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15			
*NP = Not Plastic																	

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Sheet B-20



GRAIN SIZE DISTRIBUTION CURVE

Sample No.	Location	SOIL DESCRIPTION	W%	LL	PL	PI																
TB-4, Sample 6	19 ft to 20.5 ft	Brown to gray SAND (SP)	24.9	NA	NA	NA																
U.S. Sieve Number:		3 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 200								
% Passing:		100	100	100	100	100	100	100	100	96.3	87.5	73.9	33.0	2.2								
Eff. Size (D10) =		0.09 mm		Unif. Coef. (D60/ D10) =		2.33		Intracoastal Waterway Deepening Project Taylor Engineering, Inc. Palm Beach County, FL Project Number : HD155006 Date : 3/25/15														
*NP = Not Plastic																						

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February 22, 2016

Florida Inland Navigation District
1314 Marcinski Road
Jupiter, FL 33477-9498

DUNKELBERGER
engineering & testing, inc.

A Terracon COMPANY

Project No. HD155091

Attention: Mr. Mark Crosley
Executive Director

Subject: ***Dredge Construction Observations &
Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project
Palm Beach County, Florida***

Telephone: 561 627-3386
E-mail: mcrosley@aicw.org

Dear Mr. Crosley:

Dunkelberger Engineering & Testing, A Terracon Company (DUNKELBERGER) visited the project site on Thursday, February 11, 2015 to observe the on-going dredging operations in light of the geotechnical engineering report for the project, and has researched available technologies that may be incorporated into the next proposed reach of the project. This letter provides a summary of observations made during the site visit, a qualitative discussion of how those observations compared with information provided in the geotechnical report, research of alternative subsurface investigation methods and recommendations for site characterization for future dredging projects. The work was completed in accordance with our Supplemental Agreement for Services with the Florida Inland Navigation District (FIND) dated February 5, 2016.

1.0 PROJECT CONSIDERATIONS

Taylor Engineering, Inc. (Taylor Engineering) provided contract documents which included plans, and specifications, as well as survey and geotechnical information for bidding the dredging project. The dredge project includes deepening the Intracoastal Waterway (ICWW) over a distance of approximately 3,500 feet to an elevation of -15 feet Mean Low Water (MLW), with an allowable over-dredge to Elevation -17 feet MLW. The original geotechnical report for the project was dated March 27, 2015. That report describes the finding of four borings that were drilled on a nominal horizontal spacing of 1,000 feet along the alignment of the dredge template. The borings disclosed mostly sand deposits within the anticipated dredge elevation (Elevation -17 feet MLW). Coquina limestone was found in one of the four borings above Elevation -17 feet MLW. The Contractor (Cavache) reported finding significantly more rock above the dredge level. For this reason, eleven (11) additional borings were drilled along the project alignment and the findings are described in a report dated November 13, 2015. Borings



Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL

drilled within the southern approximately two-thirds of the project contained a significant portion of Coquina limestone above the dredge line. The borings showed the northernmost approximately one-third of the contract to be mostly sand.

Cavache has pursued fulfillment of the dredging contract, and as of February 11, 2016, was approximately 85 percent complete according to their reckoning. However, Cavache reports that the northern reaches of the work continue to encounter a significant portion of Coquina limestone within the dredge template. For this reason, Taylor Engineering requested us to visit the site, observe the dredging operations and render opinions related to methodologies that may be considered to enhance site characterization for future projects.

2.0 CONSTRUCTION OBSERVATION

The project site was visited on February 11, 2016 to observe the ongoing dredging operations. Our personnel included Kevin Aubry, P.E., who authored the geotechnical engineering reports for the project. Mr. Aubry was accompanied by Mr. Yehya Siddiqui with Taylor Engineering and Mr. Wesley Gammons with Cavache. Mr. Aubry visited the Peanut Island Dredged Material Management Area (DMMA) as well as spent time with the dredge operator during actual dredging operations. The dredge is shown in the following photograph prior to start of work on February 11, 2016.



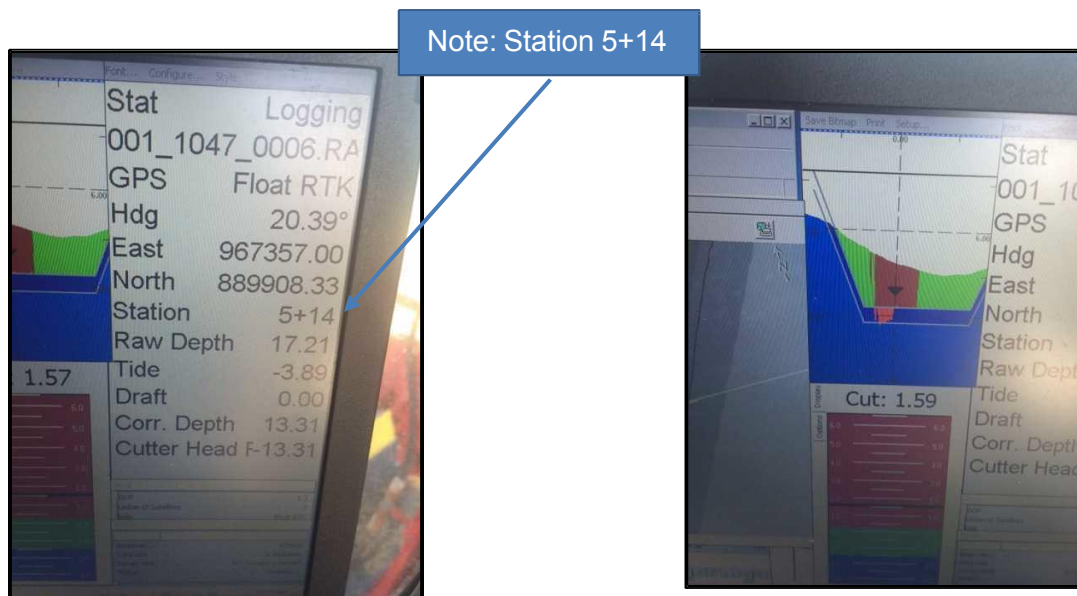
Photograph No. 1 – Dredge Equipment with Cutterhead

Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL

During the time of our site visit, the dredge was working the reach between approximately Stations 5+00 and 5+20 in Cut PB-36. The dredging operations are monitored using computer software, the ladder and dredge pumping controls within the control room on the dredge. Computer displays include data regarding the horizontal and vertical position of the cutterhead on a continuous basis. These controls are depicted in the following photographs.



Photograph No. 2 – Dredge Equipment with Ladder



Note: Station 5+14

Photograph No. 3 – Computer Data

Photograph No. 4 – Dredge Template on Computer Screen

Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL

The dredging operations were made as a radial sweep over the width of the dredge template. The sweeping motion was created by cables and pulleys at the control of the operator. Performance of the cutterhead was monitored using a gauge entitled Cutter Motor Pressure. The gauge was reading approximately 500 pounds per square inch (psi) or less when cutting sand deposits, and spiked erratically above 2,000 psi when cutting rock formations. Vibrations experienced when cutting rock formations were also significantly more noticeable compared with those developed while cutting sand deposits.

The dredge materials were moved by virtue of the cutterhead, a suction pump and a string of HDPE pipe to the existing DMMA located on Peanut Island. Twice during the approximately two hours on the dredge, the operation needed to be shut down owing to head sized cobbles and boulders getting hung up in the suction pump “Rock Box.” Reportedly, this is a frequent occurrence when cutting through the Coquina rock formation.

We visited the mouth of the dredge at the DMMA to observe the materials being disposed of there. These conditions are shown in the following photographs.



Photograph No. 5 – Dredge Material at Mouth of Dredge

Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL



Photograph No. 6 – Dredge Material Management Area

Based upon observations made at both the source of and mouth of the dredging operations, it is our opinion that a significant Coquina limestone formation is being found throughout the length of the project within the dredge template. The presence of the rock formation was not always characterized in the geotechnical data provided to the contractor. It is our opinion that vertical solution features and other undulations within the surface of the limestone formation are infilled with sands. Subsurface exploration boreholes for this project were drilled using a 3-inch or 4-inch diameter drill bit, and samples were obtained using a 2-inch diameter split barrel sampler. Geotechnical borings (TB-102 and TB-103) drilled in the vicinity of where the dredging work was on-going on February 11, 2016 (Station 5+00 to 5+20) disclosed sands and organic sands, but no rock to the maximum depths explored (Elevation -18 to -20 feet MLW).

It is apparent after field observations made for this evaluation that the diameter of the subsurface exploratory methods is significantly less than the width of the solution features and/or undulations in the rock surface. In reality, the top of the limestone formation, albeit somewhat variable, may be significantly above that predicted by geotechnical borings alone. This character of the Coquina limestone is supported by the somewhat erratic nature of the dredge cutterhead, the pressures observed on the Cutter Motor Pressure gauge, and the vibrations experienced in the control room. The vibrations are believed to coincide with locations/elevations where the cutterhead encountered the rock formation.

Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL

3.0 SITE CHARACTERIZATION METHODS

The dredging project adjacent to Peanut Island was explored originally using SPT borings drilled at a nominal spacing of 1,000 feet. Subsequently, additional SPT borings were drilled resulting in spacing between borings of approximately 200 to 300 feet. Even with this more narrow spacing, the site specific nature of the geology for this setting could not be accurately determined using conventional subsurface investigation methods. For this reason, and utilizing a “lessons learned” approach, we researched alternative methods for site characterization as described in the following paragraphs.

During research for this letter, we reviewed an article entitled “Geotechnical Investigations for Dredging Project” written by Kyle D. Johnson, Vice President of Great Lakes Dredge & Dock Company. That publication is an update of a paper presented by Mr. Johnson at the *Proceedings of the Western Dredging Association Twenty-Third Technical Conference Thirty-Fifth Texas A & M Seminar* in June 2003. It suggests a maximum spacing for borings along a linear type dredging project (such as the Intracoastal Waterway Deepening Project) of 600 feet on center. This spacing should be reduced to 300- to 400-foot centers for rock dredging projects. The borings should be drilled to at least 5 feet below grade for non-rock projects, and to 8 feet below grade for anticipated rock dredging. In areas where rock is expected, the geotechnical borings should be augmented with jet probes to determine top of rock elevations.

The article states that some error may be introduced by not correctly accounting for the influence of tidal fluctuations, and recommends the investigation take advantage of RTK vertical positioning technology for cost effective and practical vertical control. Otherwise, use of a nearby, calibrated tide gauge may be considered for this purpose.

Mr. Johnson also indicates that the use of geophysical methods such as seismic refraction and electrical resistivity can be used to provide information related to rock location and elevation. However, the use of such methods necessitates very careful correlation and calibration with physical measurements such as geotechnical borings and jet probes.

We have also researched a geophysical method known as Sub Bottom Profiling. This method has been utilized elsewhere in concert with bathymetric surveying to predict the location of rock formations and the elevation of the top of the rock formation. We have begun dialogue with John Morgan with Morgan & Eklund to see if such methodology may have application for upcoming Intracoastal Waterway deepening projects. As described above, use of this method will still require a considerable amount of ground truthing (i.e. geotechnical borings/jet probes) to provide calibration of the top of rock signatures obtained from the Sub Bottom Profiling method.

**Dredge Construction Observations & Supplemental Geotechnical Information
Intracoastal Waterway Deepening Project – Palm Beach County, FL**

4.0 CONCLUSIONS

Dredging construction observations, review of previously utilized methods for and findings of subsurface exploration for this project, and comparison of the construction observations with the findings from the subsurface exploration indicates that conventional SPT borings alone does not constitute a “best practice” for subsurface characterization in advance of a deepening project. The project corridor has a mudline that consists of sandy soils that are underlain by a formation of well cemented Coquina limestone. The presence of and elevation of the top of the limestone formation is not always accurately forecasted from the results of the SPT borings. For future deepening projects where Coquina limestone is expected within the proposed dredge template, alternative subsurface exploration methods may be considered to lessen the risk of unforeseen subsurface conditions which could lead to construction delays and claims.

5.0 GENERAL COMMENTS


This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

**Dunkelberger Engineering & Testing,
A Terracon Company**

Kevin Aubry
No. 38175
27.28.16
Kevin P. Aubry, P.E.
Geotechnical Services Manager
FL Registration No. 38175



Douglas S. Dunkelberger
FOR

Douglas S. Dunkelberger, P.E.
Principal Engineer
FL Registration No. 33317

ATTACHMENT F

LAKE WORTH LAGOON PAST PERMITS



**FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION**
SOUTHEAST DISTRICT OFFICE
400 NORTH CONGRESS AVE., THIRD FLOOR
WEST PALM BEACH, FL 33401
561-681-6600

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

January 21, 2014

Florida Inland Navigation District
c/o Mark Crosley, Managing Member
1314 Marcinski Road
Jupiter, FL 33477
Email: mcrosley@aicw.com

File No.: 50-0294306-002
Applicant: Florida Inland Navigation District- ICWW Port of Palm Beach

Dear Mr. Crosley:

Enclosed is Environmental Resource Permit No. 50-0294306-002, issued pursuant to Part IV of Chapter 373, Florida Statutes (F.S.), and Title 62, Florida Administrative Code (F.A.C.).

Appeal rights for you as the permittee and for any affected third party are described in the text of the permit along with conditions which must be met when permitted activities are undertaken. Please review this document carefully to ensure compliance with both the general and specific conditions contained herein. As the permittee, you are responsible for compliance with these conditions. **Please ensure all construction personnel associated with your activity review and understand the attached drawings and conditions.** Failure to comply with this permit may result in liability for damages and restoration, and the imposition of civil penalties up to \$10,000.00 per violation per day pursuant to Sections 403.141 and 403.161, F.S.

In addition, please ensure the construction commencement notice and all other reporting conditions are forwarded to the appropriate office as indicated in the specific conditions.

If you have any questions about this document, please contact me at (561) 681-6656 or by email at Kelly.Egan@dep.state.fl.us.

Sincerely,

A handwritten signature in black ink that reads 'Kelly Egan'.

Environmental Specialist III
Submerged Lands & Environmental
Resources Program



Permit Review Checklist

(A summary of the required monitoring and reporting activities for your project)

Pre-Construction Requirements

Activity	Date Due	Date Completed
<input type="checkbox"/> Contact DEP to Schedule Pre-construction Meeting	Prior to construction	
<input type="checkbox"/> Evidence that SFWMD File No. 50-04766-P has been Modified	Prior to construction	
<input type="checkbox"/> Submit Pre-Construction Notice Form to DEP	48 Hrs. Before Construction	
<input type="checkbox"/> Temporary Erosion & Turbidity Control Structures in Place	Prior to construction	

Construction Requirements

Activity	Date Due	Date Completed
<input type="checkbox"/> Permit with All Attachments Kept at the Work Site	Permit shall be available on-site for DEP inspector at all times	
<input type="checkbox"/> Permanent Erosion & Turbidity Control Structures in Place	Structures should be inspected daily	
<input type="checkbox"/> Turbidity Monitoring Report Changes to Permitted Drawings / Plans / Activities	As necessary, submitted weekly Contact DEP before any changes	

Post-Construction & Mitigation Requirements

Activity	Date Due	Date Completed
<input type="checkbox"/> Commencement of Required Mitigation for Hardbottom Impacts	Within 30 days of construction commencement	
<input type="checkbox"/> Restore Construction / Staging Areas	14 days after construction	
<input type="checkbox"/> Mitigation Success	Please see the attached monitoring Schedule for your project	
<input type="checkbox"/> "Completion and Certification (As-Built) Form" signed & sealed by P.E. and sent to DEP	30 days after construction	

For the above criteria that require you to contact Department, please contact the FDEP- Southeast District Office, Environmental Resources Permitting Section, 400 North Congress Avenue, 3rd Floor, West Palm Beach, FL 33401; Attention: Melissa Gil; Phone: 561-681-6636; E-mail: Melissa.Gil@dep.state.fl.us

PLEASE NOTE: As the property owner/permittee, you are ultimately responsible for ensuring that the required conditions of your permit are complied with and timely reported to the Department. Please ensure that any designated contractors or agents acting on your behalf are familiar with these requirements.

Seagrass & Hardbottom Mitigation, Monitoring, and Reporting Schedule

Seagrass Impacts & Mitigation:

To offset unavoidable impacts to 5.82-acres of seagrass habitat, the permittee shall use a total of 1.397 Functional Gain Units (FGU) from the existing Snook Islands Natural Area (SINA) as permitted in SFWMD Permit No. 50-04766-P (Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet, Exhibit B). There are 13.767 FGUs available at SINA, 75% of which (10.325 FGUs) may be used by FIND. Once the 1.397 FGUs are deducted from the SINA mitigation, 8.928 FGUs will remain available to FIND.

Hardbottom Impacts & Mitigation:

To offset unavoidable impacts to 0.15-acres of hardbottom habitat, the permittee shall install 0.12 acres (5,227 sq.ft.) of artificial reef substrate (surplus precast concrete structures) to an area within the Palm Beach County Sugar Sands Artificial Reef Area, in accordance with the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Revised 12/19/2013). Monitoring shall be conducted as follows

Activity	Date Due *All reports to be submitted w/in 30 days following monitoring event	Date Completed
<input type="checkbox"/> Time-zero monitoring event	Within 30 days following completion of hardbottom mitigation	_____
<input type="checkbox"/> 1st year – 1st annual monitoring event	1 year following Time-zero event	_____
<input type="checkbox"/> 2nd year – 2nd annual monitoring event	2 years following Time-zero event	_____
<input type="checkbox"/> 3rd year – 3rd annual monitoring event	3 years following Time-zero event	_____



**FLORIDA DEPARTMENT OF
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SOUTHEAST DISTRICT OFFICE
400 NORTH CONGRESS AVE., THIRD FLOOR
WEST PALM BEACH, FL 33401
561-681-6600

RICK SCOTT
GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

Permittee/Authorized Entity:
Florida Inland Navigation District
c/o Mark Crosley, Managing Member
1314 Marcinski Road
Jupiter, FL 33477
Email: mcrosley@aicw.com

Project Name:
FIND-ICWW Port of Palm Beach Dredge

Authorized Agent:
Taylor Engineering, Inc.
c/o Lori Brownell, Project Manager
Email: LBrownell@taylorengeering.com

Compliance Project Manager:
Melissa Gil, Environmental Specialist II
Phone: (561) 681-6636; E-mail: Melissa.Gil@dep.state.fl.us

Environmental Resource Permit - Granted

State-owned Submerged Lands Authorization –Granted

U.S. Army Corps of Engineers Authorization –Separate Corps Authorization Required

Permit No.: 50-0294306-002

Permit Issuance Date: 1/21/14

Permit Construction Phase Expiration Date: 1/21/19

www.dep.state.fl.us

**Consolidated Environmental Resource Permit
and
State-owned Submerged Lands Authorization**

Permittee /Grantee): FIND-ICWW Port of Palm Beach Dredge

Permit No: 50-0294306-002

PROJECT LOCATION

The activities authorized by this Permit and state-owned submerged lands authorization are located within the Intracoastal Waterway, Class III Waters, adjacent to P.C.N. 00-43-42-34-00-000-3000 (FIND-Owned Peanut Island Dredged Material Management Area (DMMA)) located north of the Port of Palm Beach and west of the Lake Worth Inlet (Section 34, Township 42 South, Range 43 East), in Palm Beach County (between Latitude N 26° 46' 46.73", Longitude W 80° 02' 44.78" Latitude N 26° 46' 17.10", Longitude W 80° 02' 59.82").

PROJECT DESCRIPTION

The permittee is authorized to dredge approximately 95,580 yd³ of submerged lands to a depth of minus 15 feet below mean low water, with a two foot over dredge allowance, per the attached drawings within the Intracoastal Waterway, Class III Waters. Authorized activities are depicted on the attached exhibits.

The authorized activities shall impact 5.82 acres of seagrass (*H. decipiens*-5.60 acres, *H. johnsonii*-1.5 acres, *H. decipiens/H. Johnsonii*- 0.15acres, *H. wrightii*- 0.01 acres and *H. wrightii/ H. johnsonii*-0.01 acres). To offset unavoidable impacts to 5.82-acres of seagrass habitat, the permittee shall use a total of 1,397 Functional Gain Units from the existing Snook Islands Natural Area (SINA) as permitted in SFWMD Permit No. 50-04766-P, per the attached 1-page Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet (Exhibit B).

Additionally, the authorized activities shall impact 0.15 acres of hardbottom habitat. To offset unavoidable impacts to 0.15-acres of hardbottom habitat, the permittee shall install 0.12 acres (5,227 sq.ft.) of artificial reef substrate (surplus precast concrete structures) to an area within the Palm Beach County Sugar Sands Artificial Reef Area, in accordance with the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Exhibit C).

The water depths within the navigational channel are currently between -8-feet and -21-feet at mean low water increasing in depth to the south near the Port of Palm Beach. All watercraft associated with the construction of the permitted structure shall only operate within waters of sufficient depth (one-foot clearance from the deepest draft of the vessel to the top of submerged resources) so as to preclude bottom scouring or prop dredging. Construction equipment/tools and materials shall be transported to and from the site via barge and upland roadways and all equipment/tools and materials shall be stored on the barge and uplands.

Pursuant to Section 18-21.011(3)(c), F.A.C., severance fees are not required, as the material is being placed on public property and used for public purposes.

The standard manatee conditions shall be adhered to during all in water work. All waterbodies, including the adjacent submerged aquatic vegetation outside the specific limits of construction authorized by this permit shall be protected from erosion, siltation, sedimentation, and/or scouring. Due to the nature of the project site, turbidity curtains may not be feasible; therefore, a temporary mixing zone is allowed under this permit to occur up to 150 meters down current of the construction activity (barge location). When feasible, turbidity curtains shall be placed around the dredge to prevent spoil from entering surface waters and ensure that any turbidity resulting from this project will be contained within the project boundaries. Turbidity shall be monitored and recorded outside of the turbidity curtains and at the edge of the mixing zones to ensure that turbidity levels do not exceed 29 NTUs above ambient background levels.

The project described above may be conducted only in accordance with the terms, conditions and attachments contained in this permit. The issuance of this permit does not infer, nor guarantee, nor imply that future permits or modifications will be granted by the Department.

AUTHORIZATIONS

Environmental Resource Permit

The Department has determined that the activity qualifies for an Environmental Resource Permit. Therefore, the Environmental Resource Permit is hereby granted, pursuant to Part IV of Chapter 373, Florida Statutes (F.S.), and Chapter 62-330, Florida Administrative Code (F.A.C.).

State-owned Submerged Lands Authorization

The activity is located on submerged lands owned by the State of Florida. It therefore also requires authorization, from the Board of Trustees of the Internal Improvement Trust Fund, pursuant to Article X, Section 11 of the Florida Constitution, and Sections 253.002 Florida Statutes (F.S.) and Chapter 258, F.S.

As staff to the Board of Trustees, the Department has determined that the activity is located within Easement No. 29099, and qualifies for a Letter of Consent, as long as the work performed is located within the boundaries as described herein and is consistent with the terms and conditions herein.

Federal Authorization

Authority for review - an agreement with the USACOE entitled “Coordination Agreement Between the U. S. Army Corps of Engineers (Jacksonville District) and the Florida Department of Environmental Protection, or Duly Authorized Designee, State Programmatic General Permit”, Section 10 of the Rivers and Harbor Act of 1899, and Section 404 of the Clean Water Act.

Your proposed activity as outlined on your application and attached drawings **does not qualify** for Federal authorization pursuant to the State Programmatic General Permit and a **SEPARATE permit** or authorization **may be required** from the Corps. A copy of your permit application has been forwarded to the Corps for their review. The Corps will issue their authorization directly to you or contact you if additional information is needed. If you have not heard from the Corps within 30 days from the date your application was received at the local FDEP Office, contact the Corps at 561-472-3530, for status and further information. **Failure to obtain Corps authorization prior to construction could subject you to federal enforcement action by that agency.**

Coastal Zone Management

Issuance of this authorization also constitutes a finding of consistency with Florida's Coastal Zone Management Program, as required by Section 307 of the Coastal Zone Management Act.

Water Quality Certification

This permit also constitutes a: water quality certification under Section 401 of the Clean Water Act, 33 U.S.C. 1341

Other Authorizations

You are advised that authorizations or permits for this activity may be required by other federal, state, regional, or local entities including but not limited to local governments or municipalities. This permit does not relieve you from the requirements to obtain all other required permits or authorizations.

The activity described may be conducted only in accordance with the terms, conditions and attachments contained in this document. Issuance and granting of the permit and authorizations herein do not infer, nor guarantee, nor imply that future permits, authorizations, or modifications will be granted by the Department.

PERMIT /SOVEREIGNTY SUBMERGED LANDS CONDITIONS

The activities described must be conducted in accordance with:

- **The Specific Conditions**
- **The General Conditions**
- **The General Conditions for Sovereignty Submerged Lands Authorization**
- **The limits, conditions and locations of work shown in the attached drawings**
- **The term limits of this authorization**

You are advised to read and understand these conditions and drawings prior to beginning the authorized activities, and to ensure the work is conducted in conformance with all the terms, conditions, and drawings herein. If you are using a contractor, the contractor also should read and understand these conditions and drawings prior to beginning any activity. Failure to comply with these conditions, including any mitigation requirements, shall be grounds for the Department to revoke the permit and authorization and to take appropriate enforcement action.

Operation of the facility is not authorized except when determined to be in conformance with all applicable rules and this permit and sovereignty submerged lands authorization, as described.

SPECIFIC CONDITIONS- PROJECT FORMS & ATTACHMENTS

(1) The attached 1-page permit checklist; the attached project drawings (sheets 1 through 11); the attached 1-page “Standard Manatee Conditions for In-Water Work, 2011” (Exhibit A); the attached 1-page Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet (Exhibit B); the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Exhibit C) and DEP forms 62-330.310(3), 62-330.310(1); 62-330.310(2); 62-330.340(1); and 62-330.350(1), which may be downloaded at <http://www.dep.state.fl.us/water/wetlands/erp/forms.htm> become part of this permit. If the permittee does not have access to the Internet, please contact the Department at (561) 681-6636 to request the aforementioned forms and/or document(s).

(2) If the attached permit drawings conflict with the specific conditions, then the specific conditions shall prevail.

SPECIFIC CONDITIONS - PRIOR TO CONSTRUCTION

(3) After selection of the contractor to perform the authorized activities and prior to the initiation of any work authorized by this permit, the permittee (or authorized agent) and the contractor shall attend a pre-construction conference with a representative of the Department. It shall be the responsibility of the permittee to contact this project's compliance project manager, Melissa Gil, by email Melissa.Gil@dep.state.fl.us, or by phone (561) 681-6636, to schedule the pre-construction conference.

(4) The permittee shall ensure that the permit conditions are explained to all construction personnel working on the project and for providing each contractor and subcontractor with a copy of this permit before the authorized work begins.

(5) Prior to the initiation of any dredging authorized by this permit, floating turbidity curtains with weighted skirts that extend to within one foot of the bottom shall be placed around the project site, when feasible. Additionally, staked erosion control devices shall also be installed around the perimeter of the proposed spoil management area to ensure that turbid discharges into wetlands or surface waters do not occur.

(6) The permittee shall be required to submit a Maintenance of Marine Traffic Plan. This plan is to be approved prior to issuance of the Notice to Proceed, must clearly demonstrate how the contractor will avoid disruption of ongoing traffic to the maximum extent possible.

(7) Prior to construction, the permittee shall obtain a minor modification to SFWMD Permit No. 50-04766-P. The permit modification shall indicate the number of seagrass Functional Gain Units required for the authorized activities in this permit, subtracted from the total available number of seagrass Functional Gain Units for the Snook Island Natural Area project, as funded by F.I.N.D.

SPECIFIC CONDITIONS – IMPACTS & MITIGATION REQUIREMENTS

(8) The authorized activities shall impact 5.82 acres of seagrass. To offset unavoidable impacts to 5.82-acres of seagrass habitat, the permittee shall use a total of 1.397 Functional Gains Units from the existing Snook Islands Natural Area (SINA) as permitted in SFWMD Permit No. 50-04766-P, per the attached 1-page Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet (Exhibit B).

(9) Additionally, the authorized activities shall impact 0.15 acres of hardbottom habitat. To offset unavoidable impacts to 0.15-acres of hardbottom habitat, within 30 days of commencing dredging activities, the permittee shall install 0.12 acres (5,227 sq.ft.) of artificial reef substrate (surplus precast concrete structures) to an area within the Palm Beach County Sugar Sands Artificial Reef Area, in accordance with the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Exhibit C).

(10) **Within 30 days after completing construction of the artificial reef, the permittee shall** submit to the Department a Time Zero report. The report shall include the construction date and the total volume of material installed. The report shall contain photographs, taken from referenced locations, to represent the entire site. Additionally, a drawing shall be included to show the location and direction of the camera. Subsequent monitoring reports shall be submitted annually for a period of 3 years, the first report being due one year after the Time Zero Report. The annual reports shall include the number of functional groups, a list of all species observed, the percent-coverage of native species observed, and explanations if survivorship is trending toward failure. The reports shall include photographs from the locations referenced in the Time Zero Report. The reports shall be sent via e-mail to the Department's assigned Compliance Project Manager, Melissa Gil (Melissa.Gil@dep.state.fl.us).

(11) In order for the artificial reef to be deemed successful, the artificial reef must achieve a minimum of 80% of major groups of organisms (functional groups) coverage that is currently found at the impact site and shall be present by the end of the first 3 years after placement.

(12) The responsibility to determine if the artificial reef is meeting the permit-specified success criteria shall not fall solely on the Department. Within the first 2 years after placement, if the permittee becomes aware that the project is not meeting the success criteria and probably will not meet the criteria based on site observations, then the permittee shall notify the Department at the email address in Specific Condition No. 3. The permittee shall then submit an alternative planting plan to the Department for review and approval.

SPECIFIC CONDITIONS – CONSTRUCTION ACTIVITIES

(13) The work authorized by this permit shall not be conducted on any property, other than that owned by the permittee, without the prior written approval of that property owner.

(14) All storage or stockpiling of tools or materials (i.e. lumber, pilings, debris, etc.) shall be limited to uplands. All construction equipment/tools and materials shall be transported to and from the site upland roadways and all equipment/tools and materials shall be stored on the uplands.

(15) Best management practices shall be employed during all phases of this project. All water bodies, adjacent submerged aquatic vegetation, and/or adjacent wetland resources outside the specific limits of construction authorized by this permit shall be protected from erosion, siltation, sedimentation, and/or scouring.

(16) A temporary mixing zone is authorized with this permit to occur up to 150-meters down current of the dredging location. If turbidity is visible outside of the 150-meter mixing zone, then turbidity levels shall be monitored as required in Specific Condition No's. 20 through 22.

(17) Dredging shall be conducted from a shallow draft barge with a fully loaded draft of no more than 8 feet. All watercraft associated with the construction of the permitted structure shall only operate within waters of sufficient depth (one-foot clearance from the deepest draft of the vessel to the top of submerged resources) so as to preclude bottom scouring, prop dredging, or damage to submerged resources.

(18) The material shall be mechanically or hydraulically dredged and deposited onto the existing Peanut Island DMMA. Return water shall not be discharged into areas outside of the authorized mixing zone.

(19) All areas to be dredged shall be in accordance with the attached permit drawings and shall not exceed the areas and depths indicated on those drawings.

SPECIFIC CONDITIONS – MONITORING/REPORTING REQUIREMENTS

(20) Turbidity levels outside the 150-meter temporary mixing zone shall not exceed 29 NTU's above background levels. The following measures shall be taken immediately by the permittee whenever turbidity levels within waters of the State surrounding the project site exceed 29 NTUs above background:

- a. Notify the Department at (561) 681-6636 at the time the violation is first detected.
- b. Immediately cease all work contributing to the water quality violation.
- c. Stabilize all exposed soils contributing to the violation. Modify the work procedures that were responsible for the violation, install more turbidity containment devices, and repair any non-functional turbidity containment devices.
- d. Perform turbidity monitoring.
- e. Resume construction activities once turbidity levels outside turbidity curtains fall below 29 NTUs.

(21) Turbidity Monitoring. Water turbidity levels shall be monitored every four hours if a turbidity plume is observed outside the limits of the authorized mixing zones. Samples shall be taken one foot above the bottom, mid-depth, and one-foot below the surface at monitoring stations located as follows:

- a. Approximately 100 feet up-current of the work sites and clearly outside the influence of construction activities. (This shall serve as the natural background sample against which other turbidity readings shall be compared.)
- b. Immediately outside the authorized 150-meter mixing zone surrounding the work sites and within the densest portion of any visible turbidity plume. (This sample shall serve as the compliance sample.)

(22) Turbidity Monitoring Reports. During dredging activities, the permittee or permittee's contractor shall collect the following turbidity monitoring data at the frequency and water depths directed by Specific Condition #21:

- a. Date and time of sampling event
- b. Turbidity sampling results (background NTUs, compliance NTUs, and the difference between them)
- c. Description of data collection methods
- d. An aerial map indicating the sampling locations
- e. Depth of sample(s)
- f. Weather conditions at times of sampling
- g. Tidal stage and direction of flow

Data shall be collected in a turbidity log and shall include a statement by the individual responsible for implementation of the sampling program attesting to the authenticity, precision, limits of detection, and accuracy of the data. The turbidity log shall be scanned and sent on a weekly basis to the Department’s compliance project manager, Melissa Gil, by email at Melissa.Gil@dep.state.fl.us. The subject line of the email shall include the project name, permit number, and the title “Turbidity Monitoring Reports.”

SPECIFIC CONDITIONS – MANATEE CONDITIONS

(23) During all in-water work, the permittee shall comply with the standard manatee protection construction conditions listed in the attached 1-page “Standard Manatee Conditions for In-Water Work, 2011”.

(24) To reduce the possibility of injuring or killing a manatee during construction, dredging shall not be performed during the following time of year: November 15- March 31.

(25) When in water work is being performed, at least one person shall be designated as a manatee observer. That person shall have experience in manatee observation and be equipped with polarized sunglasses to aid in observation. The manatee observer must be on site during all in-water construction activities and will advise personnel to cease operation upon sighting a manatee within 50 feet of any in-water construction activity. Movement of a work barge or other associated vessels, shall not be performed after sunset, when the potential of spotting manatees is negligible.

SPECIFIC CONDITIONS – PROTECTION OF HISTORICAL RESOURCES

(26) If prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoes, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the immediate vicinity of such discoveries. The permittee, or other designee, should contact the Florida Department of State, Division of Historical Resources, Review and Compliance Section at 850/245-6333 or 800/847-7278, as well as the appropriate permitting agency office. Project activities should not resume without verbal and/or written authorization from the Division of Historical Resources. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.

GENERAL CONDITIONS FOR INDIVIDUAL PERMITS

The following general conditions are binding on all individual permits issued under chapter 62-330, F.A.C., except where the conditions are not applicable to the authorized activity, or where the conditions must be modified to accommodate project-specific conditions.

(1) All activities shall be implemented following the plans, specifications and performance criteria approved by this permit. Any deviations must be authorized in a permit modification in accordance with Rule 62-330.315, F.A.C. Any deviations that are not so authorized may subject the permittee to enforcement action and revocation of the permit under Chapter 373, F.S.

(2) A complete copy of this permit shall be kept at the work site of the permitted activity during the construction phase, and shall be available for review at the work site upon request by the Agency staff. The permittee shall require the contractor to review the complete permit prior to beginning construction.

(3) Activities shall be conducted in a manner that does not cause or contribute to violations of state water quality standards. Performance-based erosion and sediment control best management practices shall be installed immediately prior to, and be maintained during and after construction as needed, to prevent adverse impacts to the water resources and adjacent lands. Such practices shall be in accordance with the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (Florida Department of Environmental Protection and Florida Department of Transportation June 2007), and the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual (Florida Department of Environmental Protection, Nonpoint Source Management Section, Tallahassee, Florida, July 2008), which are both incorporated by reference in subparagraph 62-330.050(9)(b)5., F.A.C., unless a project-specific erosion and sediment control plan is approved or other water quality control measures are required as part of the permit.

(4) At least 48 hours prior to beginning the authorized activities, the permittee shall submit to the Agency a fully executed Form 62-330.350(1), "Construction Commencement Notice," [October 1, 2013], which is incorporated by reference in paragraph 62-330.350(1)(d), F.A.C., indicating the expected start and completion dates. A copy of this form may be obtained from the Agency, as described in subsection 62-330.010(5), F.A.C. If available, an Agency website that fulfills this notification requirement may be used in lieu of the form.

(5) Unless the permit is transferred under Rule 62-330.340, F.A.C., or transferred to an operating entity under Rule 62-330.310, F.A.C., the permittee is liable to comply with the plans, terms and conditions of the permit for the life of the project or activity.

(6) **Within 30 days after completing construction** of the entire project, or any independent portion of the project, the permittee shall provide the following to the Agency, as applicable:

- a. For an individual, private single-family residential dwelling unit, duplex, triplex, or quadruplex – "Construction Completion and Inspection Certification for Activities Associated With a Private Single-Family Dwelling Unit" [Form 62-330.310(3)]; or
- b. **For all other activities – "As-Built Certification and Request for Conversion to Operational Phase"** [Form 62-330.310(1)].
- c. If available, an Agency website that fulfills this certification requirement may be used in lieu of the form.

(7) If the final operation and maintenance entity is a third party:

- a. Prior to sales of any lot or unit served by the activity and within one year of permit issuance, or within 30 days of as-built certification, whichever comes first, the permittee shall submit, as applicable, a copy of the operation and maintenance documents (see sections 12.3 thru 12.3.3 of Volume I) as filed with the Department of State, Division of Corporations and a copy of any easement, plat, or deed restriction needed to operate or maintain the project, as recorded with the Clerk of the Court in the County in which the activity is located.

- b. Within 30 days of submittal of the as-built certification, the permittee shall submit “Request for Transfer of Environmental Resource Permit to the Perpetual Operation Entity” [Form 62-330.310(2)] to transfer the permit to the operation and maintenance entity, along with the documentation requested in the form. If available, an Agency website that fulfills this transfer requirement may be used in lieu of the form.

(8) The permittee shall notify the Agency in writing of changes required by any other regulatory agency that require changes to the permitted activity, and any required modification of this permit must be obtained prior to implementing the changes.

(9) This permit does not:

- a. Convey to the permittee any property rights or privileges, or any other rights or privileges other than those specified herein or in Chapter 62-330, F.A.C.;
- b. Convey to the permittee or create in the permittee any interest in real property;
- c. Relieve the permittee from the need to obtain and comply with any other required federal, state, and local authorization, law, rule, or ordinance; or
- d. Authorize any entrance upon or work on property that is not owned, held in easement, or controlled by the permittee.

(10) Prior to conducting any activities on state-owned submerged lands or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund, the permittee must receive all necessary approvals and authorizations under Chapters 253 and 258, F.S. Written authorization that requires formal execution by the Board of Trustees of the Internal Improvement Trust Fund shall not be considered received until it has been fully executed.

(11) The permittee shall hold and save the Agency harmless from any and all damages, claims, or liabilities that may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment or use of any project authorized by the permit.

(12) The permittee shall notify the Agency in writing:

- a. Immediately if any previously submitted information is discovered to be inaccurate; and
- b. Within 30 days of any conveyance or division of ownership or control of the property or the system, other than conveyance via a long-term lease, and the new owner shall request transfer of the permit in accordance with Rule 62-330.340, F.A.C. This does not apply to the sale of lots or units in residential or commercial subdivisions or condominiums where the stormwater management system has been completed and converted to the operation phase.

(13) Upon reasonable notice to the permittee, Agency staff with proper identification shall have permission to enter, inspect, sample and test the project or activities to ensure conformity with the plans and specifications authorized in the permit.

(14) If any prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoes, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, work involving subsurface disturbance in the immediate vicinity of such discoveries shall cease. The permittee or other designee shall contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section, at (850) 245-6333 or (800) 847-7278, as well

as the appropriate permitting agency office. Such subsurface work shall not resume without verbal or written authorization from the Division of Historical Resources. If unmarked human remains are encountered, all work shall stop immediately and notification shall be provided in accordance with Section 872.05, F.S.

(15) 15. Any delineation of the extent of a wetland or other surface water submitted as part of the permit application, including plans or other supporting documentation, shall not be considered binding unless a specific condition of this permit or a formal determination under Rule 62-330.201, F.A.C., provides otherwise.

(16) The permittee shall provide routine maintenance of all components of the stormwater management system to remove trapped sediments and debris. Removed materials shall be disposed of in a landfill or other uplands in a manner that does not require a permit under Chapter 62-330, F.A.C., or cause violations of state water quality standards.

(17) This permit is issued based on the applicant's submitted information that reasonably demonstrates that adverse water resource-related impacts will not be caused by the completed permit activity. If any adverse impacts result, the Agency will require the permittee to eliminate the cause, obtain any necessary permit modification, and take any necessary corrective actions to resolve the adverse impacts.

(18) A Recorded Notice of Environmental Resource Permit may be recorded in the county public records in accordance with subsection 62-330.090(7), F.A.C. Such notice is not an encumbrance upon the property.

GENERAL CONDITIONS FOR SOVEREIGNTY SUBMERGED LANDS AUTHORIZATION

Any use of sovereignty submerged lands is subject to the following general conditions are binding upon the applicant and are enforceable under Chapter 253, F.S. and Chapter 258, F.S.

(1) Sovereignty submerged lands may be used only for the specified activity or use. Any unauthorized deviation from the specified activity or use and the conditions for undertaking that activity or use will constitute a violation. Violation of the authorization will result in suspension or revocation of the applicant's use of the sovereignty submerged lands unless cured to the satisfaction of the Board of Trustees.

(2) Authorization under Rule 18-21.005, F.A.C., conveys no title to sovereignty submerged lands or water column, nor does it constitute recognition or acknowledgment of any other person's title to such land or water.

(3) Authorizations under Rule 18-21.005, F.A.C., may be modified, suspended or revoked in accordance with its terms or the remedies provided in Sections 253.04, F.S. and Chapter 18-14, F.A.C.

(4) Structures or activities will be constructed and used to avoid or minimize adverse impacts to resources.

(5) Construction, use, or operation of the structure or activity will not adversely affect any species which is endangered, threatened or of special concern, as listed in Rules 68A-27.003, 68A-27.004, and 68A-27.005, F.A.C.

(6) Structures or activities will not unreasonably interfere with riparian rights. When a court of competent jurisdiction determines that riparian rights have been unlawfully affected, the structure or activity will be modified in accordance with the court's decision.

(7) Structures or activities will not create a navigational hazard.

(8) Structures will be maintained in a functional condition and will be repaired or removed if they become dilapidated to such an extent that they are no longer functional.

(9) Structures or activities will be constructed, operated, and maintained solely for water dependent purposes.

(10) The applicant agrees to indemnify, defend and hold harmless the Board of Trustees and the State of Florida from all claims, actions, lawsuits and demands in any form arising out of the authorization to use sovereignty submerged lands or the applicant's use and construction of structures on sovereignty submerged lands. This duty to indemnify and hold harmless will include any and all liabilities that are associated with the structure or activity including special assessments or taxes that are now or in the future assessed against the structure or activity during the period of the authorization.

(11) Failure by the Board of Trustees to enforce any violation of a provision of the authorization or waiver by the Board of Trustees of any provision of the authorization will not invalidate the provision not enforced or waived, nor will the failure to enforce or a waiver prevent the Board of Trustees from enforcing the unenforced or waived provision in the event of a violation of that provision.

(12) Applicant binds itself and its successors and assigns to abide by the provisions and conditions set forth in the authorization. If the applicant or its successors or assigns fails or refuses to comply with the provisions and conditions of the authorization, the authorization may be terminated by the Board of Trustees after written notice to the applicant or its successors or assigns. Upon receipt of such notice, the applicant or its successors or assigns will have thirty (30) days in which to correct the violations. Failure to correct the violations within this period will result in the automatic revocation of this authorization.

(13) All costs incurred by the Board of Trustees in enforcing the terms and conditions of the authorization will be paid by the applicant. Any notice required by law will be made by certified mail at the address shown on page one of the authorization. The applicant will notify the Board of Trustees in writing of any change of address at least ten days before the change becomes effective.

(14) This authorization does not allow any activity prohibited in a conservation easement or restrictive covenant that prohibits the activity.

NOTICE OF RIGHTS

This action is final and effective on the date filed with the Clerk of the Department unless a petition for an administrative hearing is timely filed under Sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the Department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the application.

Petition for Administrative Hearing

A person whose substantial interests are affected by the Department's action may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, F.S. Pursuant to Rule 28-106.201, F.A.C., a petition for an administrative hearing must contain the following information:

(a) The name and address of each agency affected and each agency's file or identification number, if known;

(b) The name, address, any email address, any facsimile number, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;

(c) A statement of when and how the petitioner received notice of the agency decision;

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;

(f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing by the applicant must be filed within 14 days of receipt of this written notice. Petitions filed by any persons other than the applicant, and other than those entitled to written notice under Section 120.60(3), F.S., must be filed within 14 days of publication of the notice or within 14 days of receipt of the written notice, whichever occurs first. Under Section 120.60(3), F.S., however, any person who has asked the Department for notice of agency action may file a petition within 14 days of receipt of such notice, regardless of the date of publication. The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding

initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the Department's action may also request an extension of time to file a petition for an administrative hearing. The Department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, before the applicable deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

Mediation

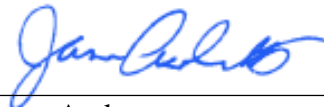
Mediation is not available in this proceeding.

Judicial Review

Once this decision becomes final, any party to this action has the right to seek judicial review pursuant to Section 120.68, F.S., by filing a Notice of Appeal pursuant to Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, M.S. 35, Tallahassee, Florida 32399-3000; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this action is filed with the Clerk of the Department.

Executed in Palm Beach County, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION



1/21/14

Jason Andreotta
Program Administrator

Submerged Lands & Environmental
Resource Program

Attachments:

Permit checklist, 1 page

Project Drawings and Design Specs., 11 pages

Exhibit A, Standard Manatee Conditions for In-Water Work, 2011, 1 page

Exhibit B, Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet, 1 page

Exhibit C, Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan, 11 pages

As-built Certification and Request for Conversion to Operational Phase Form 62-330.310(1)*

Request for Transfer to the Perpetual Operation Entity Form 62-330.310(2)*

Request to Transfer Permit Form 62-330.340(1)*

Commencement Notice Form 62-330.350(1)*

*Can be downloaded at: <http://www.dep.state.fl.us/water/wetlands/erp/forms.htm>

Copies furnished to:

Samantha Rice, USACOE Palm Beach Gardens, Samantha.L.Rice@usace.army.mil

Paul Davis, Palm Beach County ERM, pdavis@co.palm-beach.fl.us

Mary Duncan, FFWCC Bureau of Imperiled Species Management, mary.duncan@MyFWC.com

Lori Brownell, Waterfront Engineering, Taylor Engineering, Inc.

LBrownell@taylorengeering.com

FILING AND ACKNOWLEDGMENT

FILED, on this date, under 120.52(7) of the
Florida Statutes, with the designated Department Clerk,
receipt of which is hereby acknowledged.

Benny Suediho

1/21/2014

Clerk

Date



PALM BEACH COUNTY,
FLORIDA

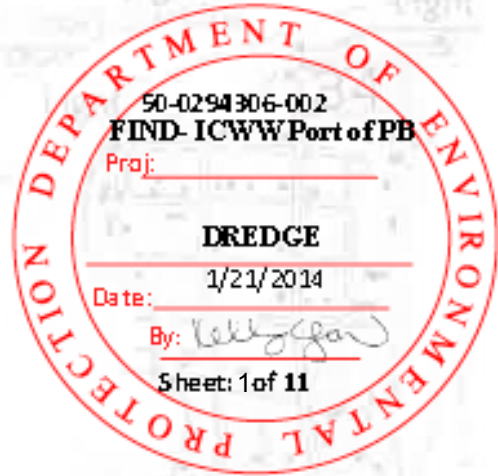
BLUE HERON BLVD.

CHANNEL
RIGHT OF WAY

LIMITS OF DREDGING (TYP)

F.I.N.D.
PEANUT ISLAND DMMA
(CAPACITY = 289,000 CY)

SECTION 34
TOWNSHIP 42S
RANGE 43E



QUAD REFERENCE:
USGS 7.5' QUADRANGLE MAP
RIVIERA BEACH, FLORIDA 1946
PHOTOREVISED 1983



NOTE:
PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT
MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

C:\P\PROJECTS\C2011-085 ICWW DEEPENING PALM BEACH HARBOUR PERMITS FIGURES\C2011-085-F-LOCATION1.MAP.DWG 2/20/2013 11:17:18 PM

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E1
LOCATION MAP
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	DRAWN BY	SHEET	DATE
C2011-085	20 CAS	1 of 11	FEB 2013

SEAL

(Signature) 7/6/13

LORI S. BROWNELL P.E.# 60025

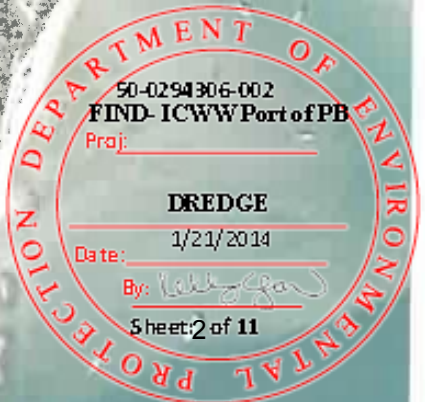
DATE

PROJECT SUMMARY

CUT LENGTH	3,555 FT
PROJECT AREA	12.24 AC
	532,963 SF
DREDGE VOLUME	95,580 CY

PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009.
2. BATHYMETRIC SURVEY: USACE, AUGUST 2010 INTRACOASTAL WATERWAY; JACKSONVILLE TO MIAMI, FLORIDA; CUTS P-34 THRU P-39 & P-52 THRU P-59; EXAMINATION SURVEY FY10; 10-FOOT PROJECT (10-113).
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



C:\T\B\ELL_X_S\PROJECTS\2011-089 ICWW DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-089-PP-PROJECT OVERVIEW.DWG 2/20/13 1:17:28 PM

TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E2
PROJECT OVERVIEW
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	21 CAS	2 of 11	FEB 2013

SEAL

[Signature] 3/6/13

LC11 S. BROWNELL P.E.# 60025 DATE

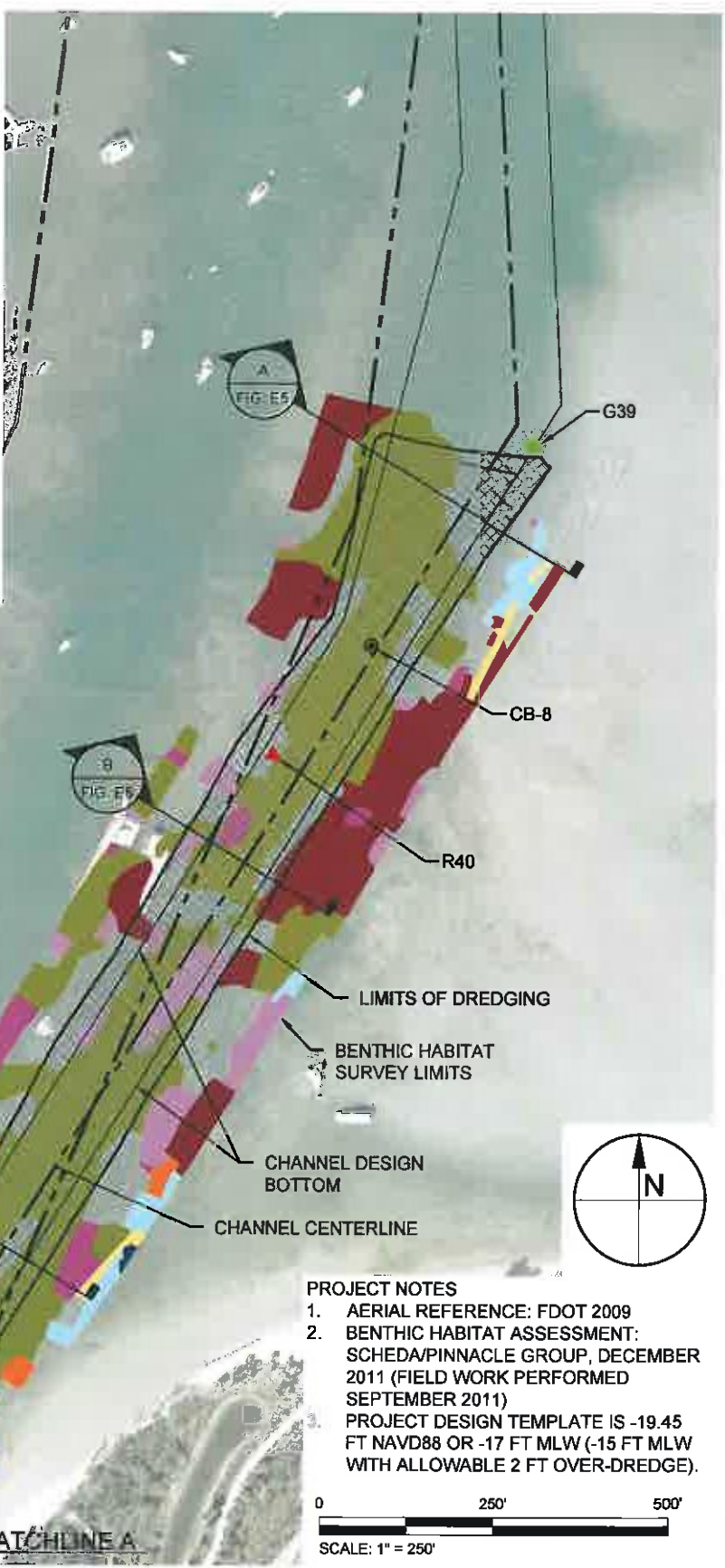
BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

LEGEND

- GREEN CHANNEL MARKER
- RED CHANNEL MARKER
- SEDIMENT CORE BORING
- LIMITS OF DREDGING

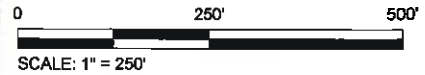
CATHY SHELL, X:\818\PROJECTS\2011-088 ICWW DEEPENING PALM BEACH HARBOUR\PERMITS\PROJ\2011-088-P-DREDGE PLAN.DWG 2/20/13 1:17:33 PM

50-0294306-002
FIND- ICWW Port of PB
 Proj: _____
DREDGE
 Date: 1/21/2014
 By: _____
 Sheet: 3 of 11



PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
 2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
- PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



MATCHLINE A

TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE E3A (WITH AERIAL)
 BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
 (NORTH)
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA**

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	22 CAS	3 of 11	FEB 2013

SEAL

LORI S. BROWNELL P.E.# 60325 DATE 2/6/13

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

LEGEND

- GREEN CHANNEL MARKER
- RED CHANNEL MARKER
- SEDIMENT CORE BORING
- LIMITS OF DREDGING

CHANNEL RIGHT OF WAY

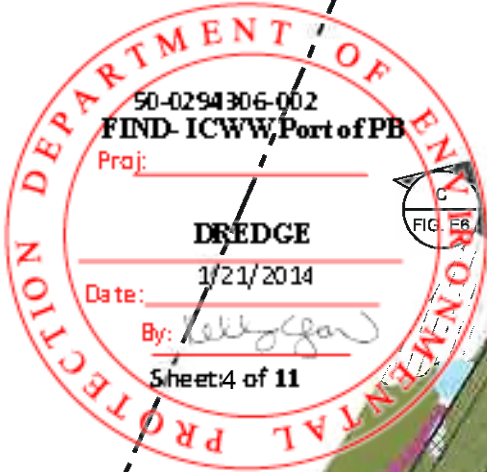
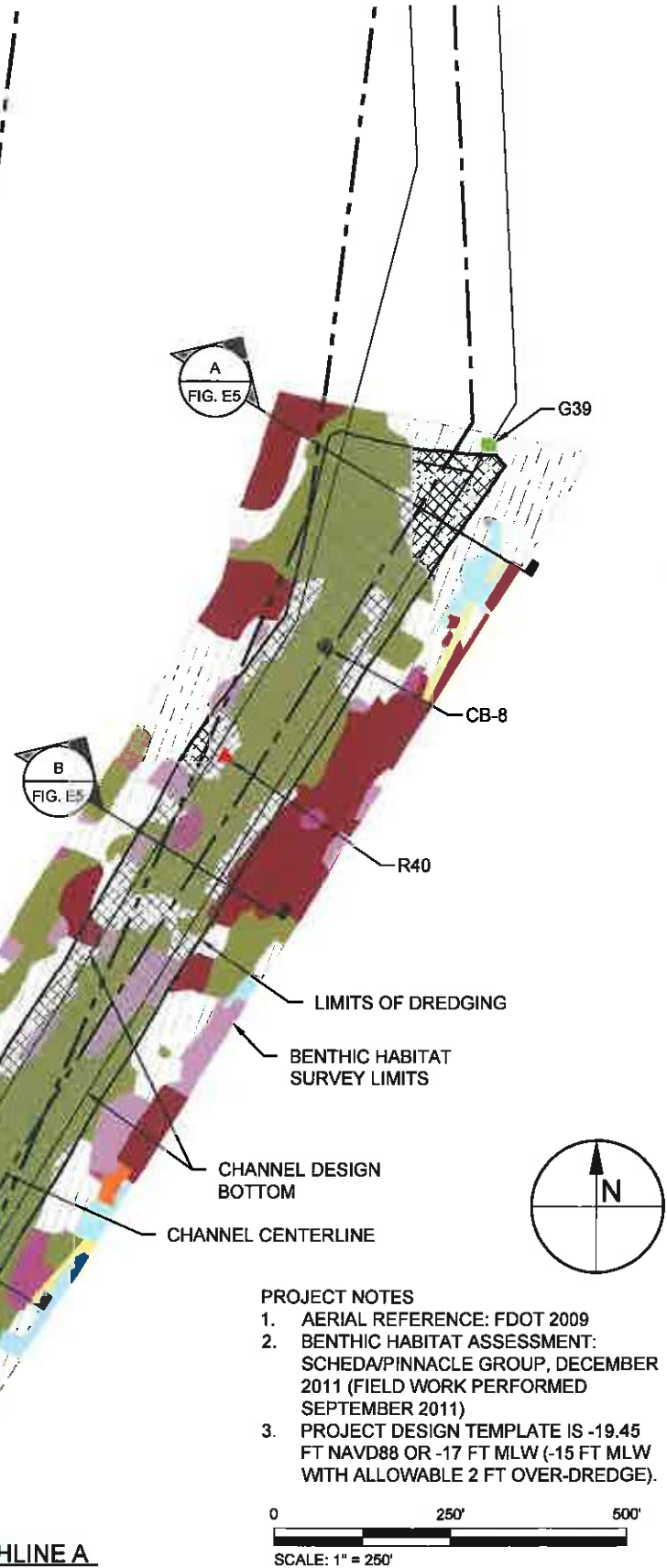


FIG. E6

MATCHLINE A



PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



C:\PROJECTS\2011-08 ICWW DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-08-P-DREDGE PLAN.DWG 2/25/2013 11:23:34 PM

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E3B (WITHOUT AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
(NORTH)
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	DRAWN BY	SHEET	DATE
C2011-08	23	CAS	4 of 11

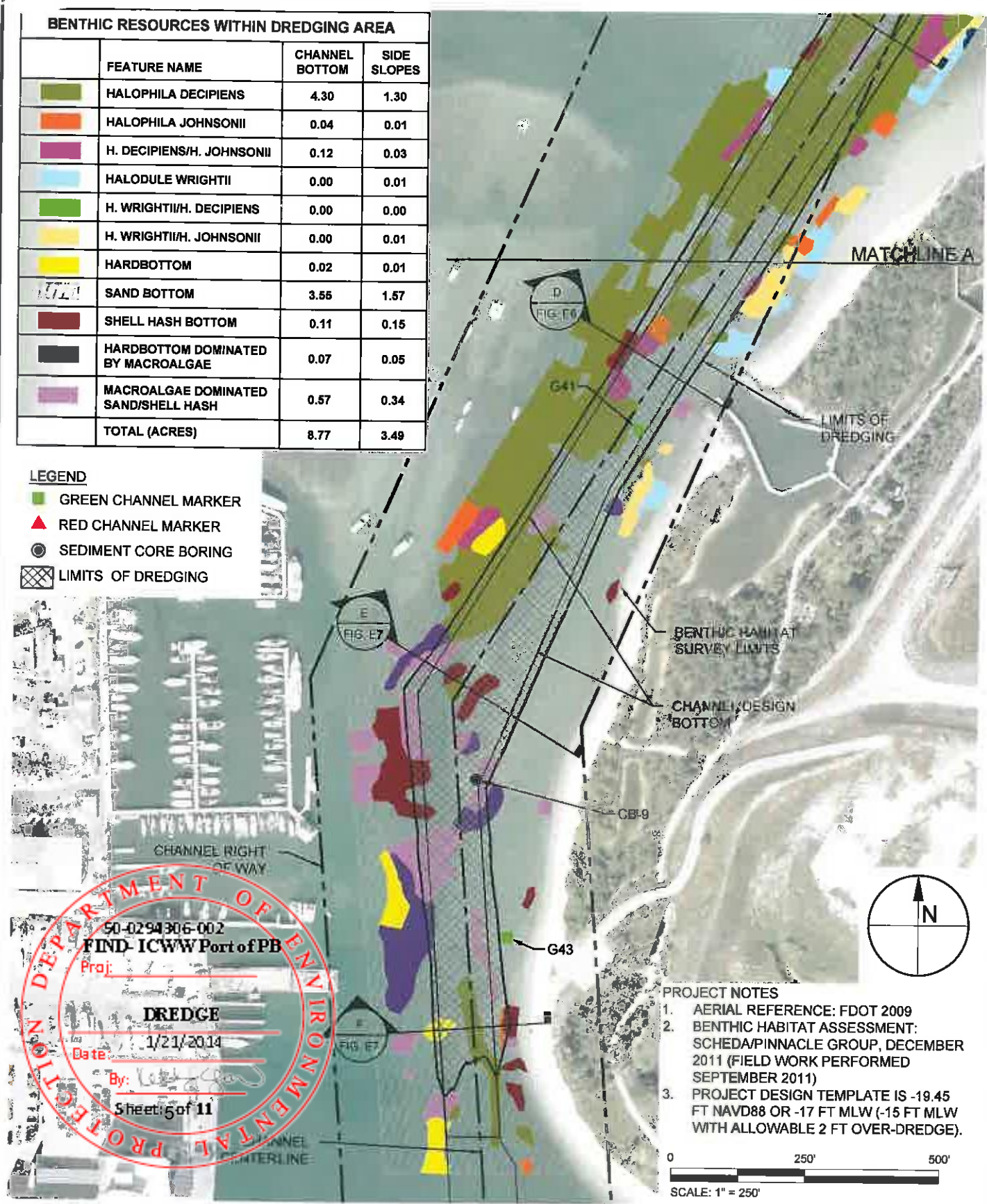
FEB 2013

SEAL

LORI S. BROWNELL, P.E.# 60025
DATE

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

- LEGEND**
- GREEN CHANNEL MARKER
 - RED CHANNEL MARKER
 - SEDIMENT CORE BORING
 - LIMITS OF DREDGING



- PROJECT NOTES**
- AERIAL REFERENCE: FDOT 2009
 - BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
 - PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

50-0294306-002
FIND- ICWW Port of PB
 Proj: _____
DREDGE
 Date: 1/21/2014
 By: _____
 Sheet 5 of 11

TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E4A (WITH AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING (SOUTH)
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

PROJECT: C2011-068 DRAWN BY: CAS SHEET: 5 of 11 DATE: FEB 2013

SEAL

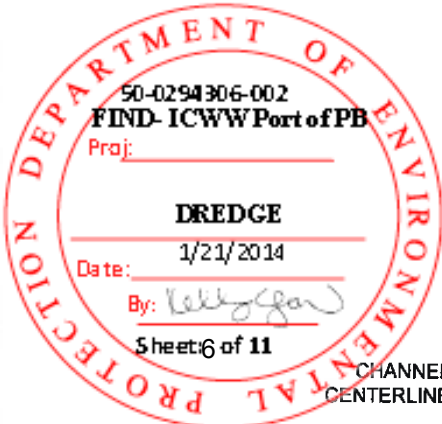
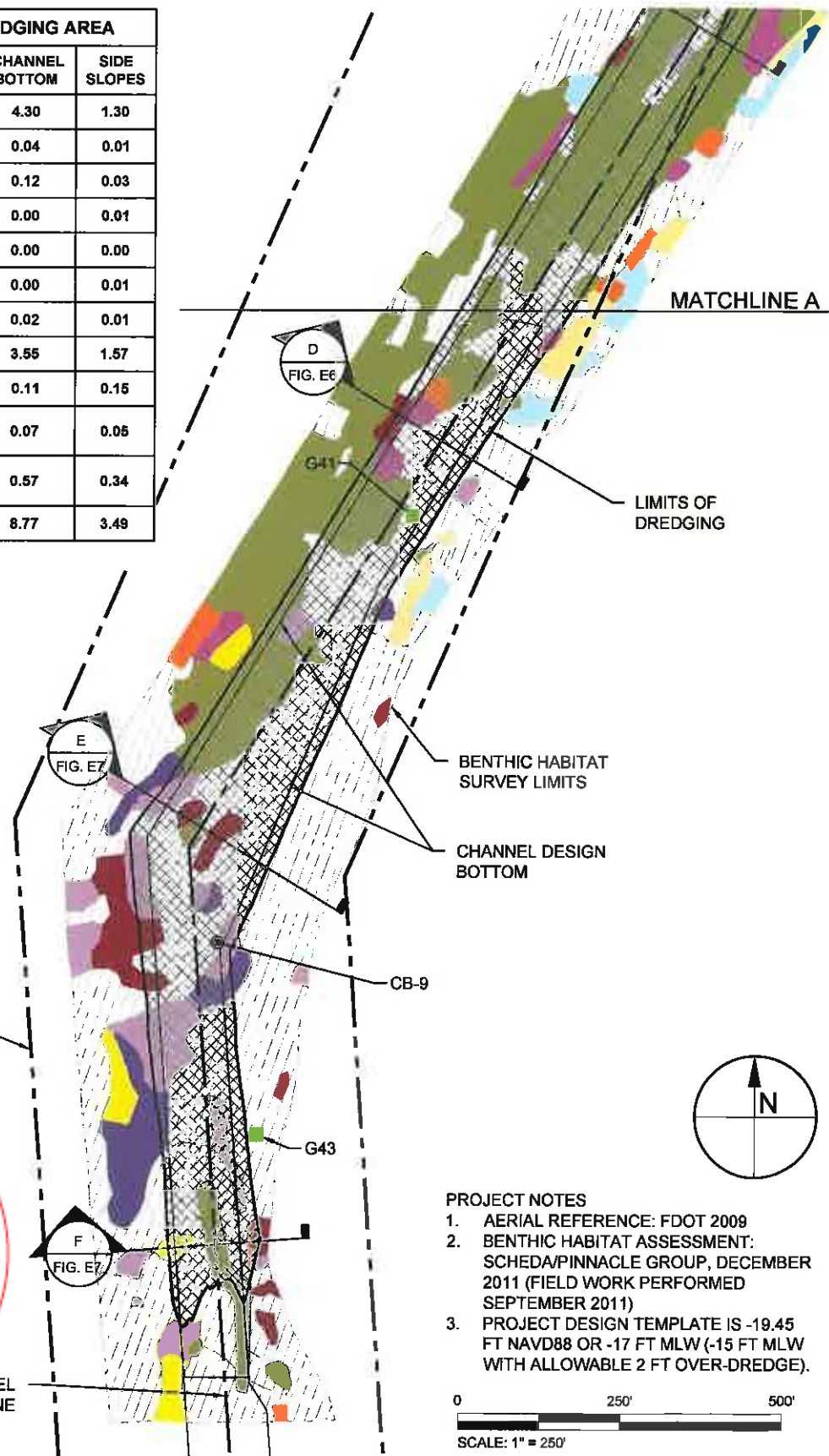
 LORI S. BROWNELL, P.E. # 60025 DATE: 3/6/13

GENTRY SHELL: X:\IS\PROJECTS\C2011-068 ICWW DEEPENING PALM BEACH HARBOR PERMITS FIGURES\C2011-068-P-DREDGE PLAN.DWG 2/26/2013 11:17:37 PM

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

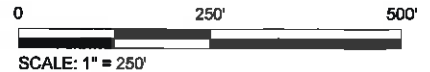
LEGEND

- GREEN CHANNEL MARKER
- RED CHANNEL MARKER
- SEDIMENT CORE BORING
- LIMITS OF DREDGING



PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



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TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4615

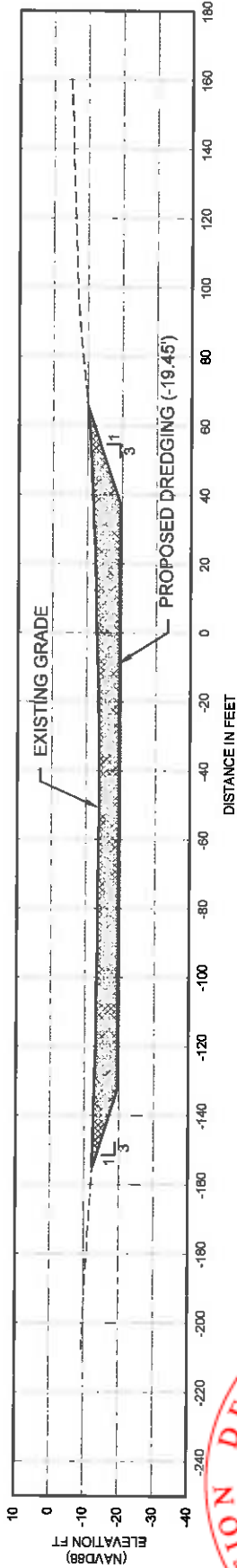
FIGURE E4B (WITHOUT AERIAL)
 BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
 (SOUTH)
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	25	CAS	6 of 11

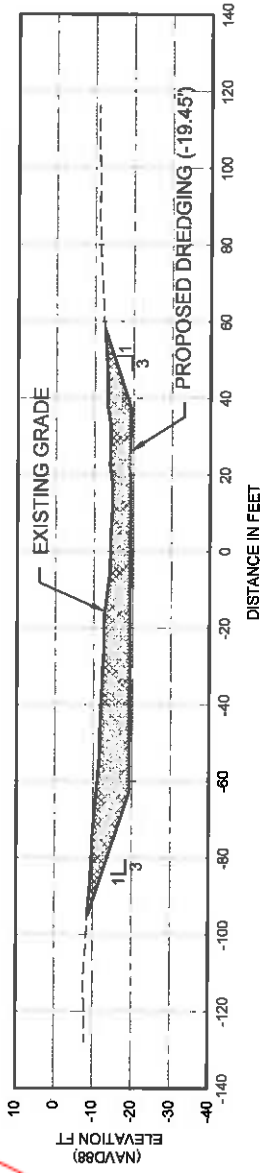
FEB 2013

SEAL

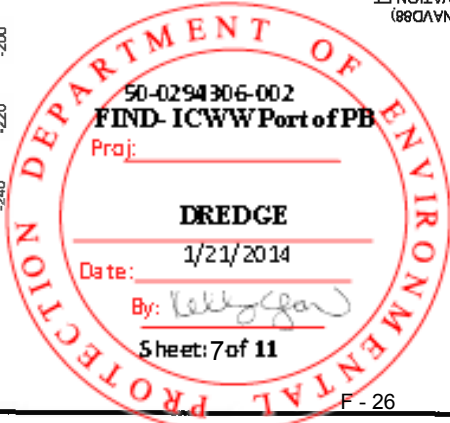
DATE



A
FIG. E3
CHANNEL CUT - TYPICAL SECTION
SCALE: 1" = 50'
V-SCALE: 1" = 50'



B
FIG. E3
CHANNEL CUT - TYPICAL SECTION
SCALE: 1" = 50'
V-SCALE: 1" = 50'



DATUM REFERENCE: NAVD88
2.45'
MLW
0.15'
MLLW
DESIGN REFERENCE: NAVD88

NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH
CONTROL TIDE STATION: 8721604 TRIDENT PIER, PORT CANAVERAL
LENGTH OF SERIES: 9 MONTHS
TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008
TIDAL EPOCH: 1983-2001

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CERTIFICATE OF AUTHORIZATION # 4815

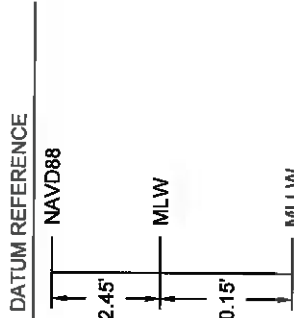
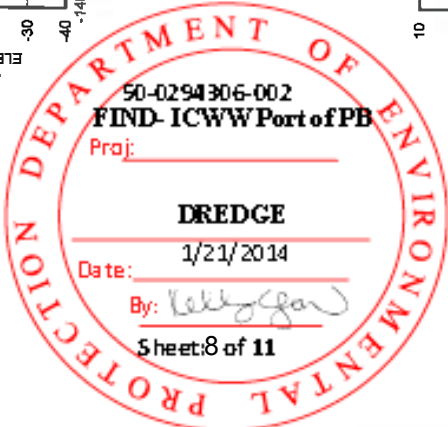
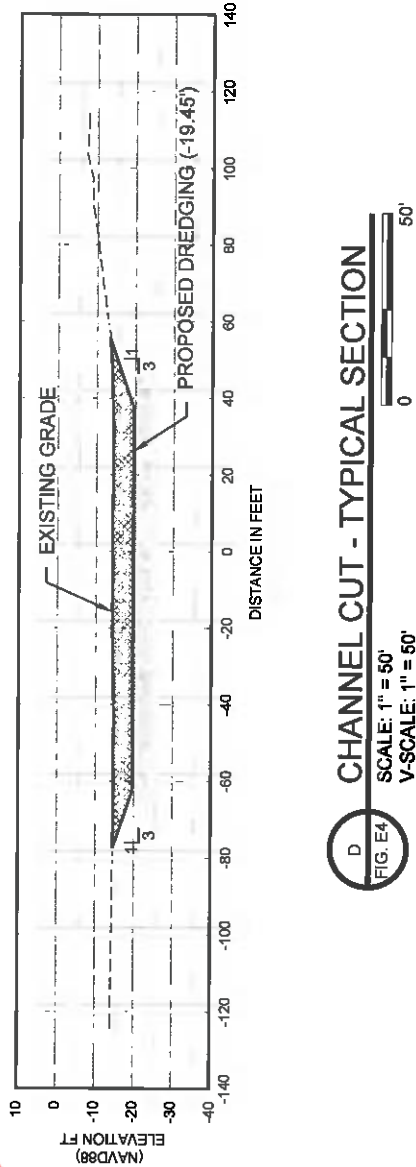
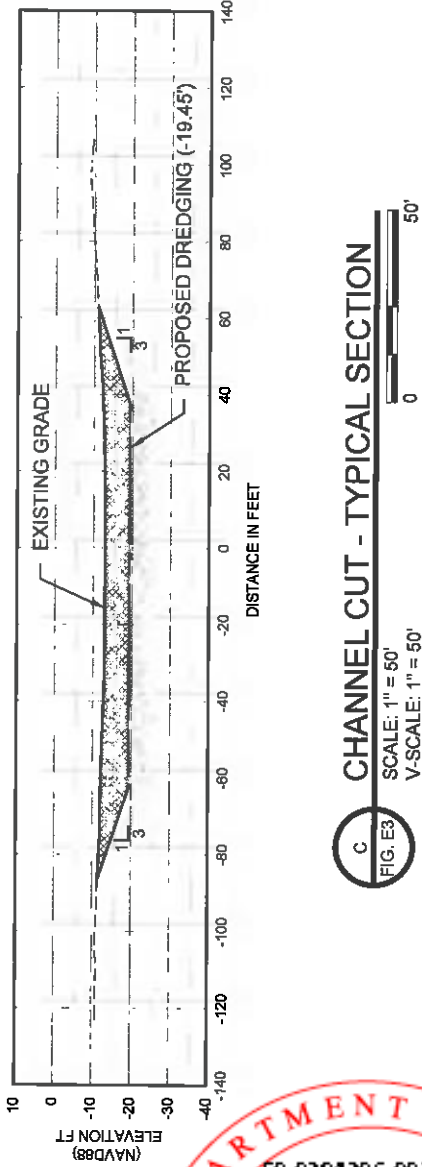
FIGURE E5
DREDGE PROFILES 1
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	C2011-068
DRAWN BY	CAS
SHEET	7 of 11
DATE	FEB 2013

SEAL
[Signature]
LORI B. BROWNELL, P.E. #0025
DATE

NOTE:
PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

PRELIMINARY DRAWINGS: THESE DRAWINGS ARE NOT IN FINAL FORM, BUT ARE BEING TRANSMITTED FOR AGENCY REVIEW.



DESIGN REFERENCE: NAVD88
NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH
CONTROL TIDE STATION: 8721604 TRIDENT PIER, PORT CANAVERAL
LENGTH OF SERIES: 9 MONTHS
TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008
TIDAL EPOCH: 1983-2001

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION #4815

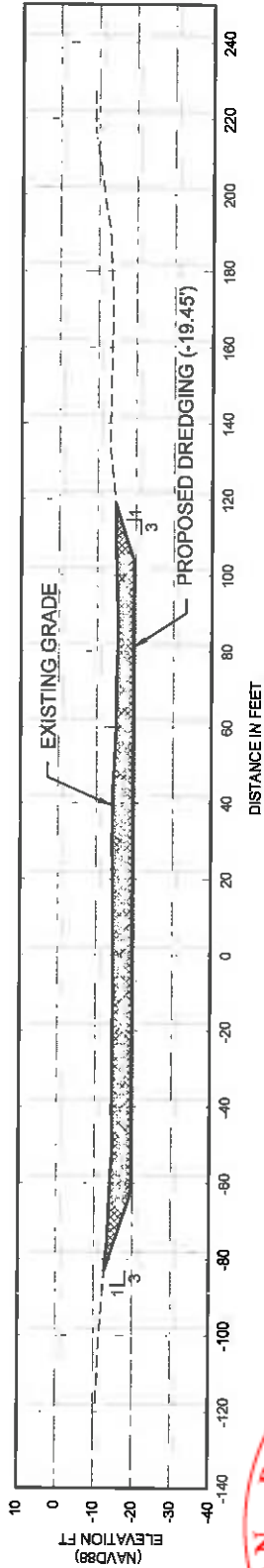
FIGURE E6
DREDGE PROFILES 2
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	C2011-068
DRAWN BY	CAS
SHEET	8 of 11
DATE	FEB 2013

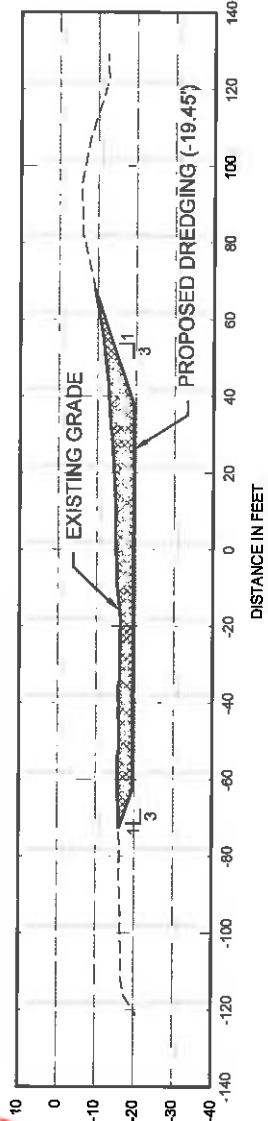
SEAL
[Signature]
LORI S. BROWNELL P.E. # 90025
DATE

NOTE:
PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

PRELIMINARY DRAWINGS: THESE DRAWINGS ARE NOT IN FINAL FORM, BUT ARE BEING TRANSMITTED FOR AGENCY REVIEW.



E
FIG. E4
SCALE: 1" = 50'
V-SCALE: 1" = 50'



F
FIG. E4
SCALE: 1" = 50'
V-SCALE: 1" = 50'

PROTECTION DEPARTMENT OF ENVIRONMENTAL

50-0294306-002
FIND- ICWW Port of PB

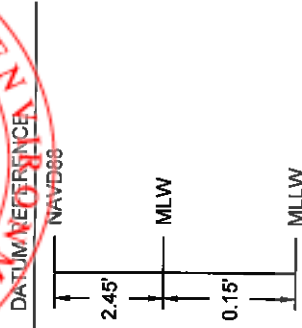
Proj: _____

Date: 1/21/2014

By: *Kelly G...*

Sheet: 9 of 11

F - 28



DESIGN REFERENCE: NAVD88

NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH
CONTROL TIDE STATION: 8721804 TRIDENT PIER, PORT CANAVERAL
LENGTH OF SERIES: 9 MONTHS
TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008
TIDAL EPOCH: 1983-2001

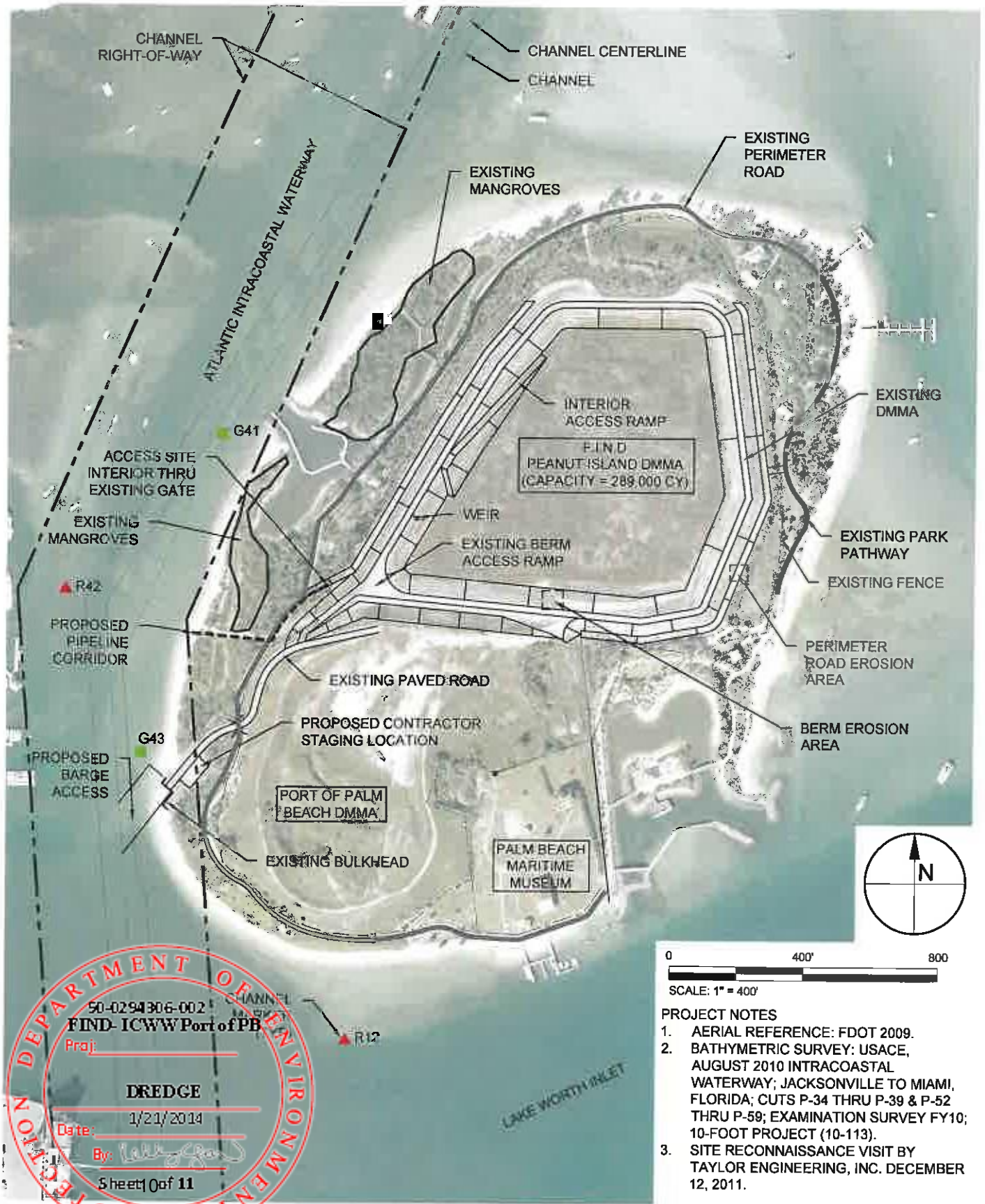
TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E7
DREDGE PROFILES 3
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	C2011-068	SEAL
DRAWN BY	CAS	
SHEET	9 of 11	
DATE	FEB 2013	

Lori S. Brownell
LORI S. BROWNELL P.E. # 80025

NOTE:
PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

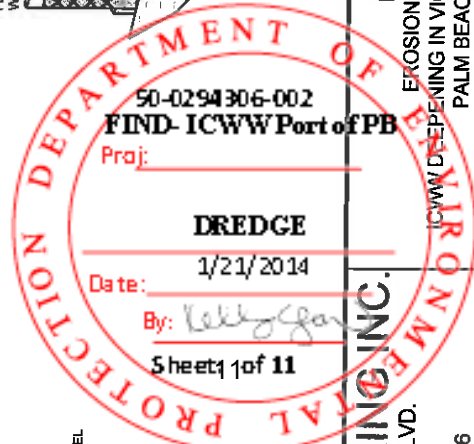
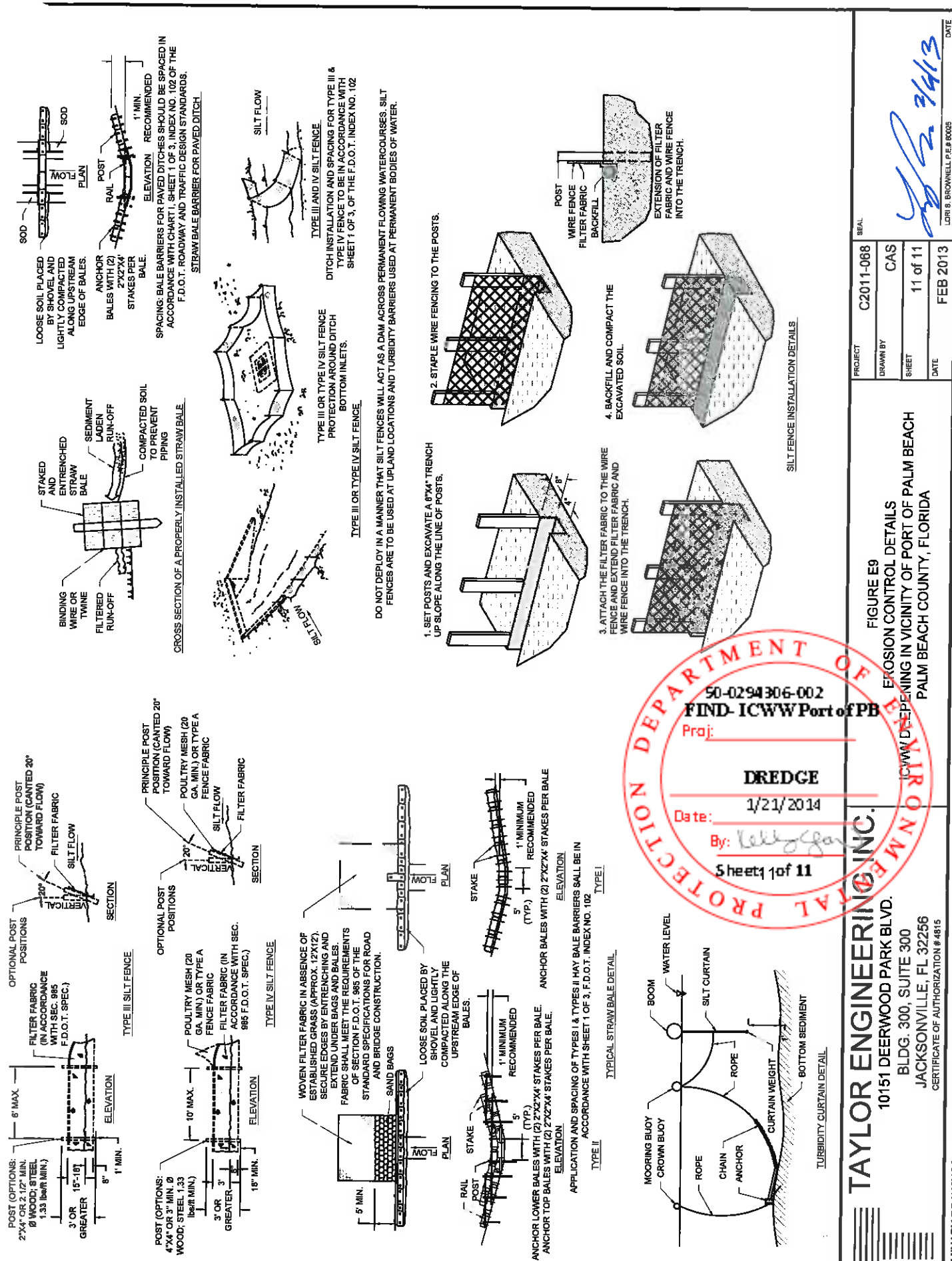


FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 50-0294306-002
FIND- ICWW Port of PB
 Proj: _____
DREDGE
 Date: 1/21/2014
 By: *[Signature]*
 Sheet 1 of 11

- 0 400' 800'
 SCALE: 1" = 400'
- PROJECT NOTES**
1. AERIAL REFERENCE: FDOT 2009.
 2. BATHYMETRIC SURVEY: USACE, AUGUST 2010 INTRACOASTAL WATERWAY; JACKSONVILLE TO MIAMI, FLORIDA; CUTS P-34 THRU P-39 & P-52 THRU P-59; EXAMINATION SURVEY FY10; 10-FOOT PROJECT (10-113).
 3. SITE RECONNAISSANCE VISIT BY TAYLOR ENGINEERING, INC. DECEMBER 12, 2011.

CATY SHELL X:\30\PROJECTS\2011-088 ICWW DEEPENING PALM BEACH MARBORDER PERMITS FIGURES\2011-088-P-DMMA.DWG 25/02/13 11:52 PM

TAYLOR ENGINEERING INC. 10151 DEERWOOD PARK BLVD. BLDG. 300, SUITE 300 JACKSONVILLE, FL 32256 CERTIFICATE OF AUTHORIZATION # 4815	FIGURE E8 EXISTING F.I.N.D. PEANUT ISLAND DMMA ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH PALM BEACH COUNTY, FLORIDA	SEAL <i>[Signature]</i> 2/24/13
	PROJECT: C2011-088 DRAWN BY: CAS SHEET: 10 of 11 DATE: FEB 2013 LORI S. BROWNELL, P.E. # 60025	



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FIGURE E9
EROSION CONTROL DETAILS
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	C2011-068
DRAWN BY	CAS
SHEET	11 of 11
DATE	FEB 2013

SEAL
DATE

[Signature]
LORI B. BROWNELL P.E. # 8005

STANDARD MANATEE CONDITIONS FOR IN-WATER WORK
2011

The permittee shall comply with the following conditions intended to protect manatees from direct project effects:

- a. All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.
- b. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.
- c. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.
- d. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.
- e. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida, and to FWC at ImperiledSpecies@myFWC.com
- f. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 ½" by 11" explaining the requirements for "Idle Speed/No Wake" and the shutdown of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at MyFWC.com/manatee. Questions concerning these signs can be sent to the email address listed above.

Exhibit A
(1 page)

Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet- FDEP 1/21/2014

Project Name	District	County	Permit No.	Date Permit Issued	Seagrass FG Units Available	Seagrass FG* Units Required (Direct)	Seagrass FG Units Required (Secondary)	Comments
Beginning Balance:					13.7670			
**Balance w/ 75% reduction:					10.3253			
ICWW- Peanut Dredge	SED	PB	FDEP 50-0294306-002	1/21/2014		1.397		Project proposes to impact 5.82 acres of seagrass
FG Units Remaining per Habitat Type					8.9283	1.397	0	

* FG units required for a project is equal to the Functional Loss as calculated by UMAM for any future projects.

**Per SFWMD Permit 50-04766-P, FIND contributed 75 percent of the funding for the construction of Snook Islands Natural Area.

**Peanut Island ICWW Deepening Project
Hardbottom Mitigation Plan
Revised 12/19/2013**

Introduction

To offset lost ecological functions resulting from removal of hardbottom as part of the ICW channel deepening construction around Peanut Island, FIND proposes to construct artificial reefs site in (to the extent practical) locations comparable to the impact. Palm Beach County has an existing, successful artificial reef program with diverse self-sustaining reefs at various locations within Lake Worth Lagoon and in the nearshore Atlantic Ocean. As the project impacts occur in Lake Worth Lagoon, FIND proposes construction of artificial reefs in the Palm Beach County Sugar Sands Artificial Reef Area (Figure 1). This area has proven to develop hard coral communities on artificial substrates. See attachments for descriptions of the communities published by Palm Beach County staff.

Required Mitigation Area

UMAM Calculation of Impact and Mitigation are provided in attachments.

$$\text{Functional Loss (FL)} = 0.021$$

$$\text{Relative Function Gain (RFL)} = 0.172$$

$$\text{FL} / \text{RFL} = 0.0221/0.172 = 0.12 \text{ acres (5,227 sf) of hardbottom mitigation required}$$

Reef location and Materials

The Sugar Sands Artificial Reef Area (Figure 1, including site corners) has current permits from the FDEP and USACE for use as an artificial reef site. FIND proposes to add artificial reef substrate (surplus precast concrete structures) to an area of the Sugar Sands site not previously used. Approximate location of the reef is shown in Figure 2. FIND contractors will work closely with Carman Vare, Palm Beach County, to define suitable placement area acceptable to Palm Beach. Magnetometer scans of the area will locate any buried utilities, which the project construction will avoid. A diver visual inspection will verify that the site does not include any artificial substrate and comprises clean sand (no seagrass). At an appropriate staging area and prior to deployment, FIND will stockpile material conforming to the standards for artificial reef substrate in The FWC recommended: **Guidelines for Marine Artificial Reef Materials 2nd Edition** accessible at:

http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_2004.pdf

The material in the staging area will be available for inspection by federal and state agency staffs 30 days before installation. The placement site borders will remain at least 75 ft from existing artificial reefs. FIND and its contractors will coordinate closely with Carmen Vare, Palm Beach County Environmental Program Supervisor during the site selection process. FIND will submit detailed artificial reef construction plans and an approval letter from Palm Beach County to the FDEP at least 30 days prior to construction.

Design and Construction

Palm Beach County has requested that the artificial reef provide the same “look and feel” as existing artificial reefs adjacent to the site. FIND will coordinate closely with Carmen Vare, Palm Beach County, on final material selection and design. However, discussions with Mr. Vare have provided the following general conceptual design:

Jersey barriers or other similar size material will provide a base for the artificial reef. The intent of the layer is to provide a support for a sand, more planar layer to create shelf-like structure. Relatively planar materials (e.g. 35 ft 14” x 14” concrete telephone poles) will create a reef shelf on top of the bottom support layer, sufficiently close together to allow the placement of 1 ft – 2 ft diameter limestone boulders as the top layer of the reef. (Figure 3: See Conceptual Reef Design – Detail). Palm Beach County will recommend boulder density. Assuming a 35 ft x 35 ft square for a reef unit (1,225 sf using the example materials), units 35 ft on a side and one unit 35 x 18 unit and 10-20 ft corridors between the units will provide more than the required mitigation area (see Figure 4: Conceptual Reef Unit Size and Spacing)

$$\text{Mitigation Reef Area} = (1,225 \text{ sf} \times 3) + (1,225 \times 0.5) + (10 \times 35 \times 3) = 5337.5 \text{ sf}$$

(3 units) + (½ unit) + (10 ft corridors)

The size of a unit will be determined by the size of the available materials. The total number of reef units and internal corridors will meet or exceed the required square foot total. If Jersey Barriers are not available other materials such as culvert junction boxes or other materials of similar scale to the Jersey Barrier can be used in a similar fashion.

The corridors between the reef units are included in the mitigation calculations because the open bottom is part of the reef community resource.

The total height of the reef is expected to be 6-9 ft, depending on the materials available for construction. Materials and final designs will be developed with the help of Mr. Carmen Vare, Palm Beach County, who will approve the final design.

The construction crew will include divers and barge-based workers. Buoys placed prior to the arrival of the barge will mark the corners of the site. The barge will locate as necessary to place materials as needed to create the required design. The work crew will move the barge as construction proceeds. Placement of buoys and barge location will employ GPS with sub-meter accuracy. The barge operator will then deploy the materials from the edge of the barge using a crane or other suitable equipment to deploy the material one or a few pieces at a time. Divers will guide final placement in communication with the barge crew and periodically inspect the deployment results to verify that the material remains within the site boundaries and remain within an elevation of ten feet. As the Sugar Sands site lies at 25 – 30 ft deep, the elevation meets the criteria in 62-341.600 F.A.C General Permit for the construction of artificial reefs 1(d) governing the elevation of the reef. The objective of the deployment is to create a set of relatively contiguous artificial reefs covering 0.12 acres (5,227 sf). At completion of construction all buoys will be removed. Construction is expected to require one day, but may extend to a second day depending on the method of deployment and the weather.

During construction, best management practices will include the use of one full time, independent, FWC-approved observer for observers for manatees, marine turtles, and smalltooth sawfish. If any of these species comes within 50 ft of the barge, all work must stop until the animal has moved away. Divers will also watch for these species and notify the topside crew to stop work if they see any of these species. The contractor will not harass or otherwise act in ways meant to cause the animal to move away. Work will recommence after the animal has moved away.

The site substrate is clean sand and the material is clean concrete. When the material reaches the bottom, very localized and temporary turbidity may occur, but the work will generate no turbidity plume. Therefore, no turbidity curtains or monitoring is warranted.

Final inspection of the deployment (which will occur within five working days of deployment) will include GPS location of the outer edges of the artificial reef and final elevations, as well as any other notes or observations. A final report submitted to the state and federal environmental permitting staffs and Palm Beach County will detail the construction activity and final inspection findings.

Within 30 days of placement of the reef material, FIND “shall notify the National Ocean Service, National Oceanographic and Atmospheric Association, U.S. Department of Commerce, Rockville, Maryland, and the Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, via e-mail at artificialreefdeployments@myfwc.com of the precise location of the reef” (62-341.600 General Permit for the Construction of Artificial Reefs).

Monitoring

The baseline monitoring effort, which will establish baseline conditions and sampling locations for success monitoring will occur as soon as possible (within 30 days) post-construction. Baseline efforts will include

- Establishment of four fixed monitoring transects and four permanent quadrat sampling sites along each transect.
- Collection of video along each transect and photographs at each of four fixed quadrat monitoring locations along each transect. Transect locations shall be preselected at the post-construction baseline monitoring effort to span the east-west and north-south dimensions of the reef.

Approximately 50 non-overlapping frame-grabbed images will be extracted from each transect video. A unique set of 20 random points shall be generated at the time of frame-grabbing and stored with each set of images so that the same points are assessed during each monitoring event. This also ensures that each person examining a particular image will view the same points, thereby allowing for double-blind counting for quality assurance and control purposes. Ten percent (10%) of the images shall be counted by two scorers to assess inter-observer variability. Calculation of percent biological cover percent cover (projected to the surface) will be performed for each image according to the following functional groups/categories:

- macroalgae (identification and percent cover of two dominant species within quadrat),
- microalgae/cyanobacteria,
- encrusting calcareous algae, sponges (genus level), with a separate assessment of percent cover of boring sponge (*Cliona* spp),
- tunicates (with identification of dominant genera),
- zoanthids (genus level), hydroids,
- wormrock (*Phragmatopoma lapidosa*),
- octocorals (genus level), and
- scleractinian corals (species level).

- solitary tunicates, urchins, and
- holothuroids within the quadrat.

The remainder of each video transect shall be reviewed for qualitative changes in benthic community cover/composition in comparison to the pre-construction surveys, previous annual surveys, and the reference sites.

During each survey, a 0.25 square meter (0.5 m by 0.5 m) gridded quadrat will be sampled by the diver/biologist at each location selected at the baseline monitoring event. A list of the locations of the quadrats along each transect with a description of the quadrat location/benthic community shall be provided to the FDEP and USACE after transect establishment.

Within each quadrat, visual estimate of percent cover and genus/species identification shall be performed *in situ* for the following functional groups:

- macroalgae (identification and percent cover of two dominant species within quadrat),
- microalgae/cyanobacteria,
- encrusting calcareous algae, sponges (genus level), with a separate assessment of percent cover of boring sponge (*Cliona* spp),
- tunicates (with identification of dominant genera),
- zoanthids (genus level), hydroids,
- wormrock (*Phragmatopoma lapidosa*),
- octocorals (genus level), and
- scleractinian corals (species level).
- solitary tunicates, urchins, and
- holothuroids within the quadrat.

Individual counts shall be conducted for all octocorals, scleractinian corals, and sponges (not including *Cliona* spp., which shall be assessed for percent cover). Maximum and average algal height of the two dominant microalgae species shall also be recorded. Average algal height shall be estimated by five measurements.

The maximum physical relief of hardbottom from the lowest point to highest point in the quadrat shall be measured to the nearest centimeter.

Success monitoring will occur annually for at least two (3) years post-construction.

Because artificial reefs are among the most common type of mitigation that successfully offsets loss of ecological functions due to hardbottom impacts, the time lag was determined to be short (3 years) to replace lost ecological functions for the relatively simple macroalgae / turf algae dominated community found in the impact areas. Note that artificial reefs at the proposed site have developed coral reef communities. Based on those results, the proposed artificial reefs are expected eventually to provide much more complex hardbottom habitat than that lost in the channel deepening.

Each transect shall be sampled using digital video in progressive scan mode, and survey date and location coordinates will be superimposed on the final deliverable. The diver shall swim at a speed of approximately 20 meters/6 minutes (~3.5 meters/minute) with a constant camera distance of 25 cm above bottom during the portions of the transect to be quantitatively analyzed. For the remainder of the 150-meter transect, the diver shall swim at a speed of 20 meters/5 minutes (~4-5 meters/minute) with a constant camera distance of 25 cm. If the diver is moved off the transect by surge or current, the diver shall return to the point where he/she was disturbed by the wave action, and resume filming at that point. The video transects shall be reviewed during the course of the survey to ensure that there are no gaps in the data due to diver error and that the quality of the video is acceptable for video analysis.

Any missing video transect data or poor quality video shall be re-filmed during the course of the event.

Landscape panoramic views shall be recorded with the digital video camera at the start and end of each transect, and at each interruption of the transect by a sand gap/recommencement at the start of the next piece of substrate. Additionally, close-up video of the tag marking the eyebolt at the start and end of each transect shall be filmed for a frame of reference for the observer viewing the video record. Close-up digital still video and/or photographs shall be obtained of representative benthos along each transect to aid in identification during video analysis. Still photographs shall be obtained using the digital video camera or digital still camera at all quadrat locations and hard coral colonies (if observed) along the transect. Voucher sampling of macroalgae shall be conducted as needed to assist with video identification of macroalgae genera.

Lag Time for Community Development

Because artificial reefs are among the most common type of mitigation that successfully offsets loss of ecological functions due to hardbottom impacts, the time lag was determined to be short (3 years) to replace lost ecological functions for the relatively simple macroalgae / turf algae dominated community found in the hardbottom impact areas.

Success Criteria

Evaluation of the artificial reef(s) success as mitigation will occur via the results of the annual biological monitoring. A UMAM analysis, pursuant to rule (Ch. 62-345, F.A.C.), will be performed using the collected quantitative and qualitative data from both the biological monitoring and mitigation reef(s) monitoring. If UMAM scoring indicates that ecological functions have been effectively offset, the mitigation reef(s) will be deemed a success. UMAM factors include acreages of both impact and mitigation sites, as well as scoring of ecological functions lost or provided at the impact and mitigation sites, respectively. Functions will be assumed offset if 80% of species found in the impact site shall be present in the mitigation site by the time of the completion of the monitoring period; 2) percent cover by the major groups of organisms (functional groups) in the mitigation site shall be no less than it was in the impact site.

Reporting

All data deliverables shall be provided within 90 days after completion of each mitigation reef survey.

The deliverables will include the following data on CD:

- _ all digital video transects and frame-grabbed images from all transects
- _ PointCount files and associated data (i.e. PTS files, MGR files, cd.dat files)
- _ Excel spreadsheets of PointCount data (raw data and summary files)
- _ Excel spreadsheets of *in situ* quadrat data
- _ Spatial GIS shapefiles of transects

A report summarizing the monitoring (permanent transects, quadrats) and analyses will be prepared. The report shall include appropriate graphics/tables, statistical analysis of the collected data, and assessment of ecological functions provided by the mitigation as compared to those provided at the impact site. The report shall be provided within 90 days after completion of the survey in both hard copy and digital format.

If after three (3) annual monitoring events, it is determined that the installed mitigation reef(s) do not adequately offset lost ecological functions, FIND will consult with FDEP and USACE, identify probable causes, take agreed upon corrective actions, and as appropriate extend monitoring for one to two additional annual monitoring events.

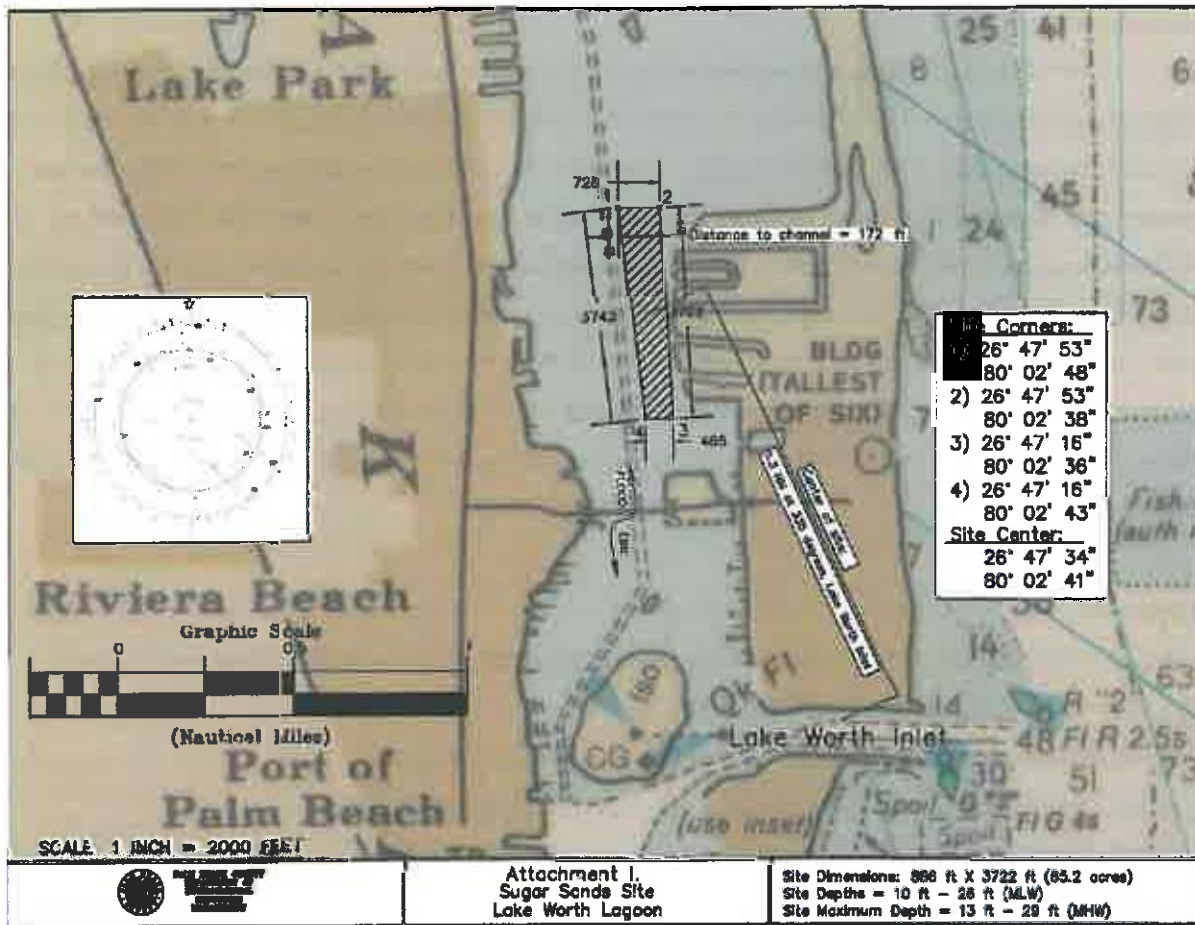


Figure 1. Location of Sugar Sands Artificial Reef Site in Lake Worth Lagoon

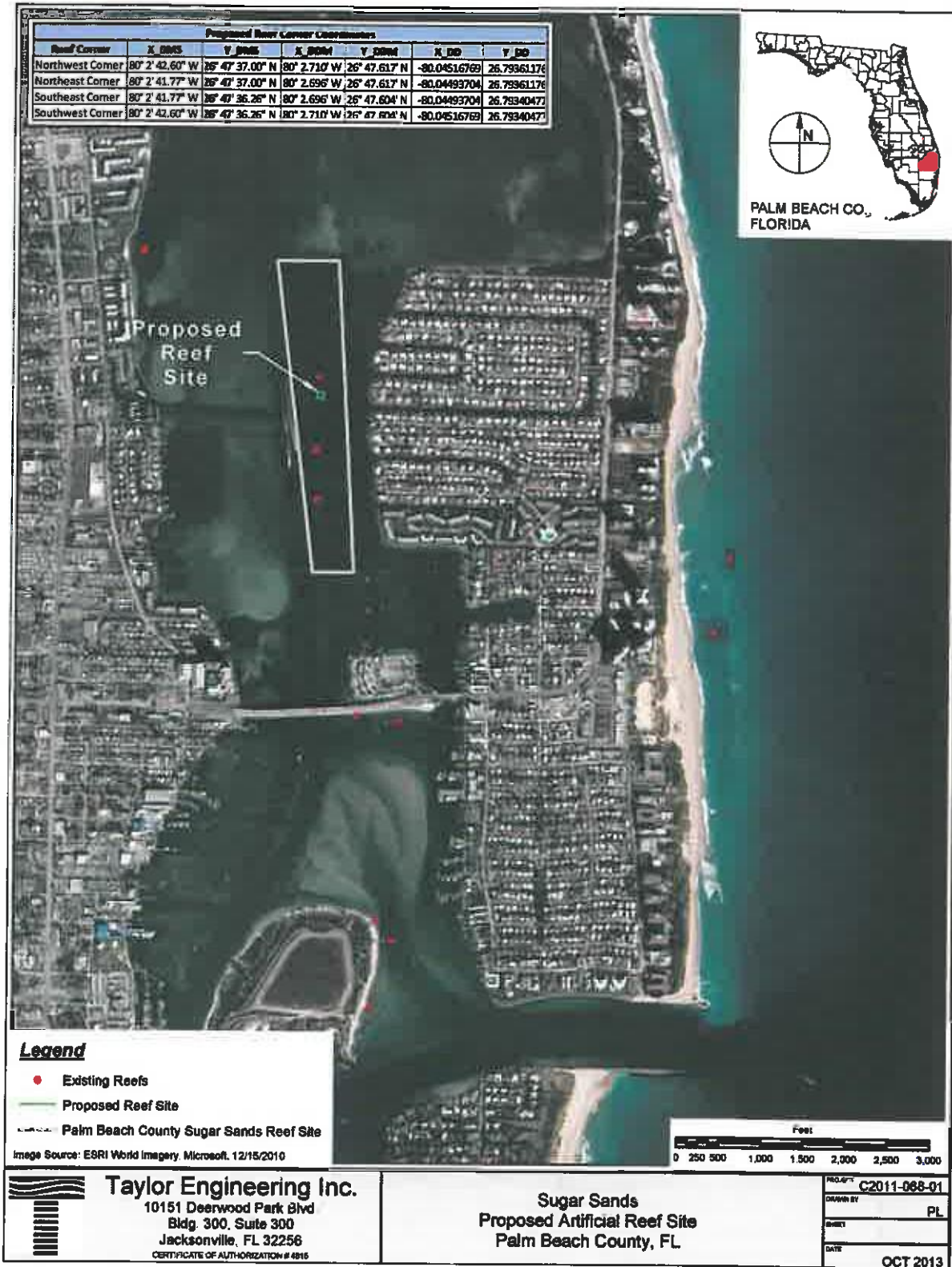
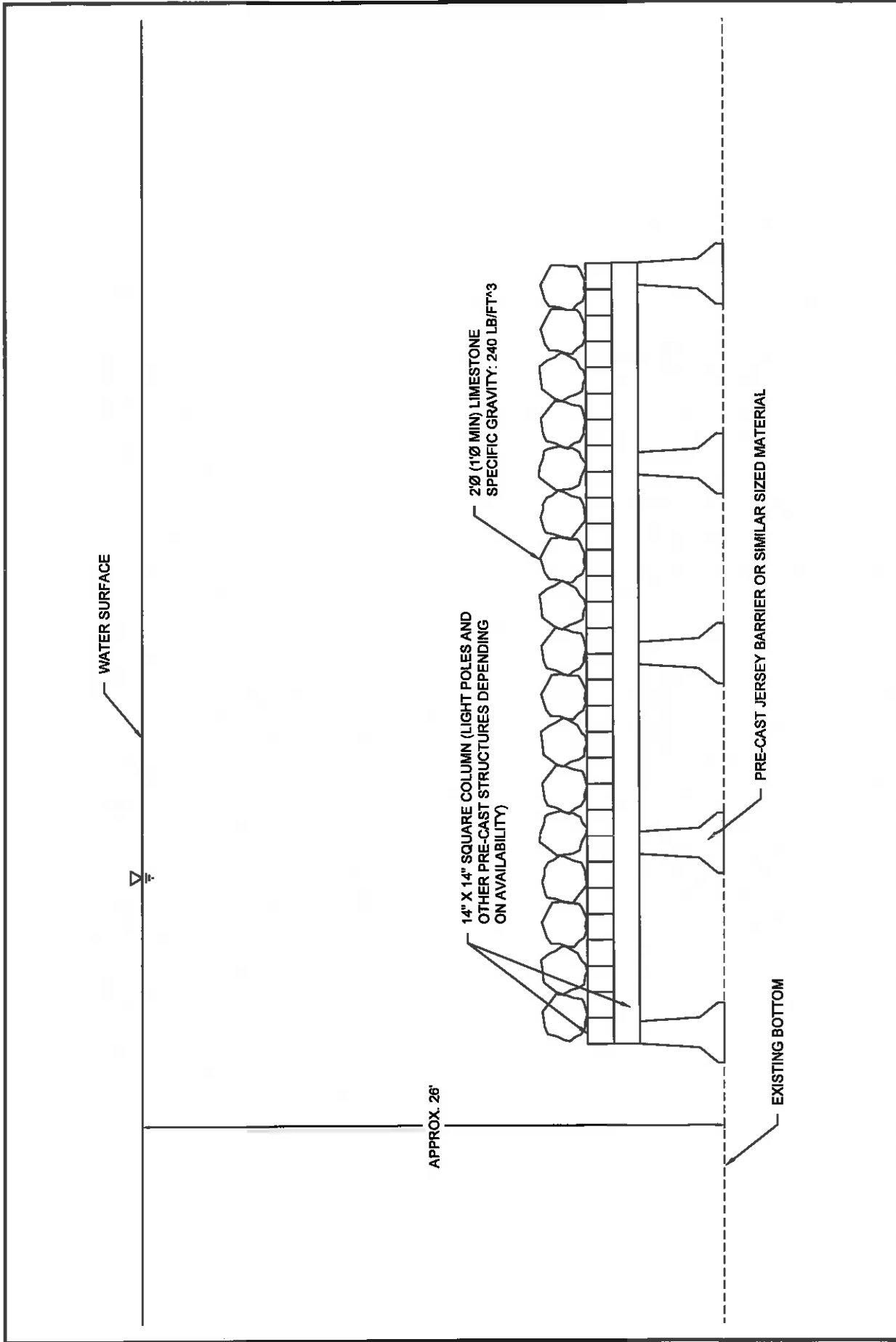


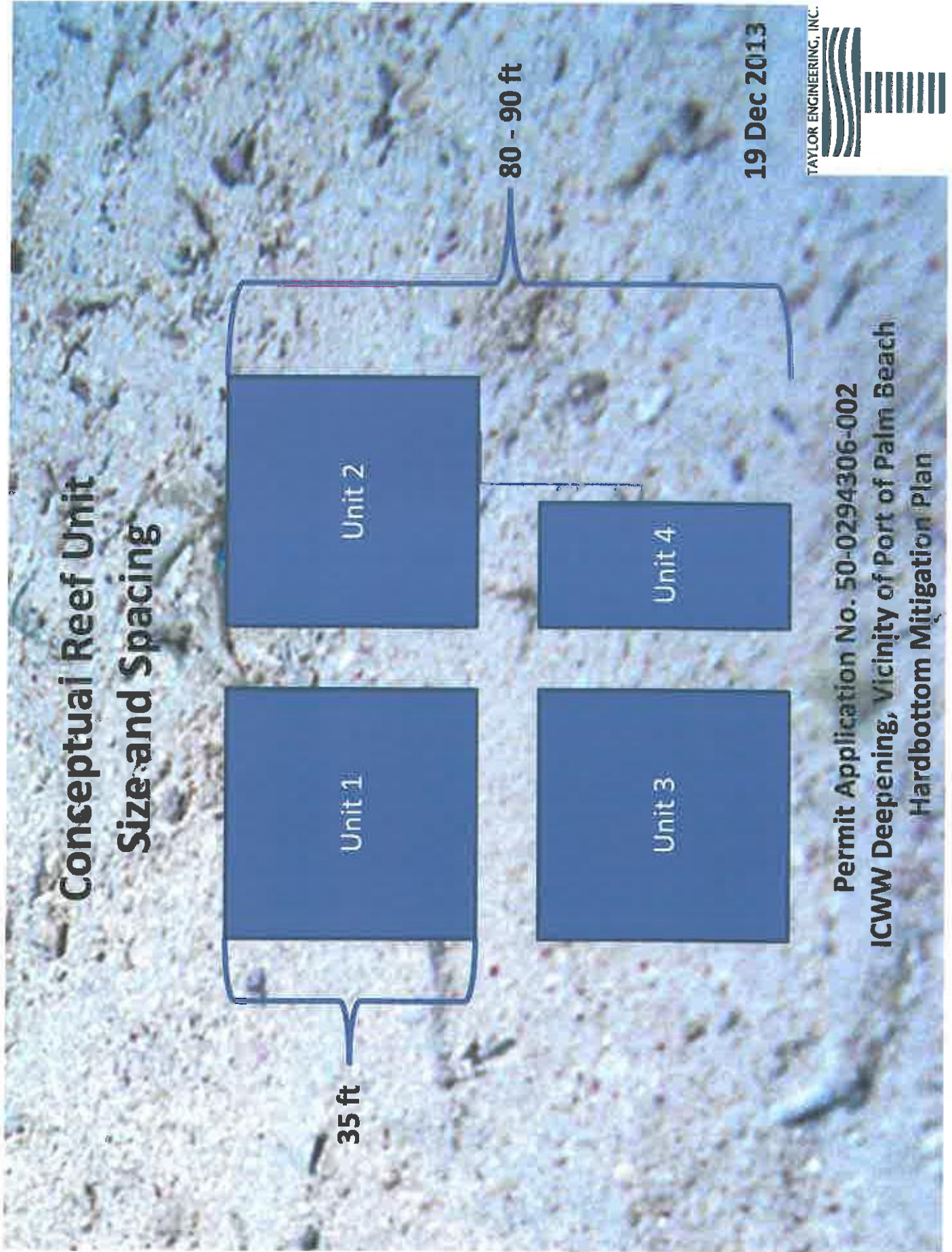
Figure 2. Proposed Location of 0.12 Acre Mitigation Reef in the Sugar Sands Artificial Reef Site



<p>TAYLOR ENGINEERING INC. 10151 DEERWOOD PARK BLVD. BLDG. 300, SUITE 300 JACKSONVILLE, FL 32256 CERTIFICATE OF AUTHORIZATION # 4815</p>	<p>FIGURE 3 CONCEPTUAL REEF DESIGN DETAILS Permit Application No. 50-0294306-002</p>	<p>PROJECT</p>
	<p>DATE</p>	<p>DRAWN BY</p>
	<p>DATE</p>	<p>SHEET</p>
	<p>DATE</p>	<p>DEC 2013</p>

PRELIMINARY DRAWINGS: THESE DRAWINGS ARE NOT IN FINAL FORM, BUT ARE BEING TRANSMITTED FOR AGENCY REVIEW.

ANTON-D:\ATM\REF\817TES\CONCEPTUAL REEF DESIGN.DWG 12/19/2013 5:42 PM





**FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION**

SOUTHEAST DISTRICT OFFICE
3301 GUN CLUB ROAD, MSC 7210-1
WEST PALM BEACH, FL 33406
561-681-6600

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA
LT. GOVERNOR

CLIFFORD D. WILSON III
INTERIM SECRETARY

December 24, 2014

Florida Inland Navigation District
c/o Mark Crosley, Managing Member
1314 Marcinski Road
Jupiter, FL 33477
Sent via Email: mcrosley@aicw.com

Re: File Name: Florida Inland Navigation District- ICWW Port of Palm Beach
File No.: 50-0294306-003
Modification of File No.: 50-0294306-002

Dear Mr. Crosley:

Your request to modify this permit has been received and reviewed by Department staff. This modification clarifies when dredging may be performed.

PROJECT LOCATION

The project is located within the Intracoastal Waterway, Class III Waters, adjacent to P.C.N. 00-43-42-34-00-000-3000 (FIND-Owned Peanut Island Dredged Material Management Area (DMMA)) located north of the Port of Palm Beach and west of the Lake Worth Inlet (Section 34, Township 42 South, Range 43 East), in Palm Beach County (between Latitude N 26° 46' 46.73", Longitude W 80° 02' 44.78" Latitude N 26° 46' 17.10", Longitude W 80° 02' 59.82").

The above modification is not expected to adversely affect water quality and will not be contrary to the public interest provided the following **SPECIFIC CONDITION** is amended and added to the permit as issued. Please note that additions are underlined and deletions are stricken:

SPECIFIC CONDITIONS

(24) To reduce the possibility of injuring or killing a manatee during construction, backhoe / excavator dredging activities will be permitted to take place 24 hours per day, except between ~~shall not be performed during the following time of year:~~ November 15 and March 31, during which time, backhoe / excavator dredging activities will only be permitted during daylight hours. The use of clamshell dredge will be prohibited at night throughout the year; while hydraulic dredging activities will be permitted to take place 24 hours per day throughout the year.

Since the proposed modification is not expected to result in any adverse environmental impact or water quality degradation, the permit is hereby modified as requested. By copy of this letter, we are notifying all necessary parties of the modifications.

Permittee: Florida Inland Navigation District- ICWW Port of Palm Beach
File No.: 50-0294306-003
Modification of Permit No.: 50-0294306-002
Page 2 of 4

This letter of approval does not alter the original expiration date of January 21, 2019, and does not change the original General or Specific Conditions (except as modified herein), or monitoring requirements of the permit (except as modified herein). This letter must be attached to the original permit.

NOTICE OF RIGHTS

This action is final and effective on the date filed with the Clerk of the Department unless a petition for an administrative hearing is timely filed under Sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the Department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the application.

Petition for Administrative Hearing

A person whose substantial interests are affected by the Department's action may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, F.S. Pursuant to Rule 28-106.201, F.A.C., a petition for an administrative hearing must contain the following information:

- (a) The name and address of each agency affected and each agency's file or identification number, if known;
- (b) The name, address, any email address, any facsimile number, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;
- (c) A statement of when and how the petitioner received notice of the agency decision;
- (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
- (e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;
- (f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
- (g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

Permittee: Florida Inland Navigation District- ICWW Port of Palm Beach
File No.: 50-0294306-003
Modification of Permit No.: 50-0294306-002
Page 3 of 4

Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing by the applicant must be filed within 21 days of receipt of this written notice. Petitions filed by any persons other than the applicant, and other than those entitled to written notice under Section 120.60(3), F.S., must be filed within 21 days of publication of the notice or within 21 days of receipt of the written notice, whichever occurs first. Under Section 120.60(3), F.S., however, any person who has asked the Department for notice of agency action may file a petition within 21 days of receipt of such notice, regardless of the date of publication. The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the Department's action may also request an extension of time to file a petition for an administrative hearing. The Department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, before the applicable deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

Mediation

Mediation is not available in this proceeding.

FLAWAC Review

The applicant, or any party within the meaning of Section 373.114(1)(a) or 373.4275, F.S., may also seek appellate review of this order before the Land and Water Adjudicatory Commission under Section 373.114(1) or 373.4275, F.S. Requests for review before the Land and Water Adjudicatory Commission must be filed with the Secretary of the Commission and served on the Department within 20 days from the date when this order is filed with the Clerk of the Department.

Judicial Review

Once this decision becomes final, any party to this action has the right to seek judicial review pursuant to Section 120.68, F.S., by filing a Notice of Appeal pursuant to Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, M.S. 35, Tallahassee, Florida 32399-3000; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this action is filed with the Clerk of the Department.

Permittee: Florida Inland Navigation District- ICWW Port of Palm Beach
File No.: 50-0294306-003
Modification of Permit No.: 50-0294306-002
Page 4 of 4

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION



12/24/14

Jason Andreotta
Program Administrator
Submerged Lands & Environmental
Resources Program

Date

Copies furnished to:

Kelly Egan, FDEP Permitting, Kelly.Egan@dep.state.fl.us
Daniel Krinsky, FDEP Compliance and Enforcement, Daniel.Krinsky@dep.state.fl.us
Tim Rach, FDEP SLERC, Timothy.Rach@dep.state.fl.us
Samantha Rice, USACOE Palm Beach Gardens, Samantha.L.Rice@usace.army.mil
Mary Duncan, FWC Bureau of Imperiled Species Management, mary.duncan@MyFWC.com
Kellie Youmans, FWC Bureau of Imperiled Species Management, Kellie.Youmans@myfwc.com
Lori Brownell, Taylor Engineering, Inc. LBrownell@taylorengeering.com

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52(7),
Florida Statutes, with the designated Department Clerk,
receipt of which is hereby acknowledged.



Clerk

Date

OCULUS: ERP/Permitting Auth./ERP_294306/Permit Final/ERP Modifications-EM/003



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
4400 PGA BOULEVARD, SUITE 500
PALM BEACH GARDENS, FLORIDA 33410

December 17, 2014

REPLY TO
ATTENTION OF

Palm Beach Gardens Regulatory Office
SAJ-2012-01719 (SP-AAZ)

Florida Inland Navigation District
Attn: Mark Crosley, Executive Director
1314 Marcinski Road
Jupiter, Florida 33477

Dear Mr. Crosley:

The U.S. Army Corps of Engineers (Corps) is pleased to enclose the Department of the Army permit, which should be available at the construction site. Work may begin immediately but the Corps must be notified of:

- a. The date of commencement of the work,
- b. The dates of work suspensions and resumptions of work, if suspended over a week, and
- c. The date of final completion.

This information should be mailed to the Special Projects and Enforcement Branch of the Regulatory Division of the Jacksonville District at 4400 PGA Boulevard, Suite 500, Palm Beach Gardens, Florida 33410. The Special Projects and Enforcement Branch is also responsible for inspections to determine whether Permittees have strictly adhered to permit conditions.

**IT IS NOT LAWFUL TO DEVIATE FROM
THE APPROVED PLANS ENCLOSED.**

Sincerely,

A handwritten signature in black ink that reads "Tori K. White".

Tori K. White
Chief, Regulatory Division

Enclosures

Copies Furnished:

Taylor Engineering, Inc. by email
EPA, West Palm Beach, Florida by email
NMFS, West Palm Beach Florida by email
CESAJ-RD-PE



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
4400 PGA BOULEVARD, SUITE 500
PALM BEACH GARDENS, FLORIDA 33410

REPLY TO
ATTENTION OF

November 7, 2014

Regulatory Division
South Permits Branch
Palm Beach Gardens Permits Section
SAJ-2012-01719 (SP-AAZ)

Florida Inland Navigation District
Attn: Mark Crosley, Executive Director
1314 Marcinski Road
Jupiter, Florida 33477

Dear Mr. Crosley:

The U.S. Army Corps of Engineers (Corps) has completed the review and evaluation of your Department of the Army permit application, file number SAJ-2012-01719 (SP-AAZ), for the Florida Inland Navigation District dredging of the Intracoastal Waterway adjacent to Peanut Island. Our regulations require that you have an opportunity to review the terms and conditions prior to final signature by the Department of the Army. Enclosed is an unsigned Department of the Army permit instrument (permit).

Please read carefully the Special Conditions beginning on page 2 of the permit. These were developed to apply specifically to your project. Water Quality Certification is also required prior to issuance of a permit. The Corps has received a copy of the State of Florida certification for your project. In accordance with General Condition 5 of the permit, any special conditions of the Water Quality Certification have been attached to the Department of the Army permit.

Instructions for Objecting to Permit Terms and Conditions: This letter contains an initial proffered permit for your proposed project. If you object to certain terms and conditions contained within the permit, you may request that the permit be modified. Enclosed you will find a Notification of Administrative Appeal Options and Process fact sheet and Request for Appeal (RFA) form. If you choose to object to certain terms and conditions of the permit, you must follow the directions provided in Section 1, Part A and submit the completed RFA form to the letterhead address.

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria under 33 CFR Part 331.5, and that it has been received by the District office within 60 days of the date of the RFA. Should you decide to submit an RFA form, it must be received at the letterhead address by **January 5, 2015**.

-2-

Instructions for Accepting Terms and Conditions and Finalizing Your Permit: It is not necessary to submit an RFA form to the District office, if you do not object to the decision in this letter. In this case, the permit must be signed by the applicant in the space provided on the signature page of the permit. In the case of corporations, acceptance must be by an officer of that corporation authorized to sign on behalf of the corporation. The party responsible for assuring the work is done in accordance with the permit terms and conditions must sign the permit. Please type or print the name and title of the person signing below the signature and the date signed.

SIGN (PAGE 15) AND RETURN THE ENTIRE PERMIT, INCLUDING ALL ATTACHMENTS, TO THE LETTERHEAD ADDRESS.

The permit will be signed by the District Engineer or his representative. The Corps will add the permit expiration date to the permit, the permit issuance date on the *Notice of Department of the Army Permit* form, and return the permit to you. It is important to note that the permit is not valid until the District Engineer or his representative signs it.

Thank you for your cooperation with our permit program. The Corps' Jacksonville District Regulatory Division is committed to improving service to our customers. We strive to perform our duty in a friendly and timely manner while working to preserve our environment. We invite you to complete our automated Customer Service Survey at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey. Please be aware this Internet address is case sensitive; and, you will need to enter it exactly as it appears above. Your input is appreciated – favorable or otherwise.

If you have any questions concerning this application, you may contact Alisa Zarbo in writing at the letterhead address, by electronic mail at Alisa.A.Zarbo@usace.army.mil, or by telephone at 561-472-3506.

Sincerely,



Tori K. White
Chief, Regulatory Division

Enclosures

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Florida Inland Navigation District		File Number: SAJ-2012-01719	Date: 11/7/2014
Attached is:		See Section below	
X	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A	
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B	
	PERMIT DENIAL	C	
	APPROVED JURISDICTIONAL DETERMINATION	D	
	PRELIMINARY JURISDICTIONAL DETERMINATION	E	

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **OBJECT:** If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **APPEAL:** If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT:** You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- **APPEAL:** If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

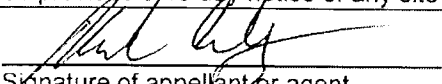
If you have questions regarding this decision and/or the appeal process you may contact:

Project Manager as noted in letter

If you only have questions regarding the appeal process you may also contact:

Bob Barron 904-232-2203

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.


 Signature of appellant or agent.

Date:
 12/16/14

Telephone number:
 861-627-3386

DEPARTMENT OF THE ARMY PERMIT

Permittee: Florida Inland Navigation District
c/o Mark Crosley, Executive Director
1314 Marcinski Road
Jupiter, Florida 33477

Permit No: SAJ-2012-01719 (SP-AAZ)

Issuing Office: U.S. Army Engineer District, Jacksonville

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: Florida Inland Navigation District (FIND) is authorized to dredge approximately 95,580 cubic yards of material from within a 12.25-acre portion of the Intracoastal Waterway (ICW) (3,555 linear feet) to a depth of -15 feet mean low water (MLW), plus a 2 foot over-dredge allowance. The dredging would be conducted via mechanical and/or hydraulic means with the dredged material placed within the Peanut Island Dredged Material Management Area (DMMA), which has a capacity of 289,000 cubic yards. The project would impact a total of 0.15 acre of hardbottom habitat and 5.82 acres of seagrasses. The work described above is to be completed in accordance with the submitted design drawings (11 pages) as indicated in Attachment 1, and the six (6) additional attachments affixed at the end of this permit instrument.

Project Location: The project is located in the ICW, west of the Peanut Island DMMA, Riviera Beach (Section 34, Township 42 South, Range 43 East), in Palm Beach County, Florida.

Directions to site: The project site is located just south of the Blue Heron Bridge generally west of Peanut Island. From Interstate I-95 in Palm Beach County, take exit # 76, State Road 708, Blue Heron Boulevard. Travel east approximately 3 miles to US Highway 1. Turn right (south) on US Highway 1 (Broadway Blvd). Jim Barry Lighthouse Park boat ramp will be on your right in approximately 0.5 mile.

Approximate Central Coordinates:

Northern Boundary:	Latitude 26.780°	Longitude -80.046°
Southern Boundary:	Latitude 26.771°	Longitude -80.050°

PERMIT NUMBER: SAJ-2012-01719 (SP-AAZ)
PERMITTEE: Florida Inland Navigation District
PAGE 2 of 17

Permit Conditions

General Conditions:

1. The time limit for completing the work authorized ends on **November 6, 2019**. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature and the mailing address of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

1. Permit Availability: The Permittee shall provide all contractors associated with construction of the authorized activity a copy of the permit and drawings. A copy of the permit shall be available on the work vessels and at the construction site at all times.

PERMIT NUMBER: SAJ-2012-01719 (SP-AAZ)
PERMITTEE: Florida Inland Navigation District
PAGE 3 of 17

2. Reporting Address: The Permittee shall submit all reports, notifications, documentation, and correspondence required by the general and special conditions of this permit to the following addresses:

a. For standard mail: U.S. Army Corps of Engineers, Regulatory Division, Special Projects and Enforcement Branch, 4400 PGA Boulevard Suite 500, Palm Beach Gardens, FL 33401, Attention: José Rivera.

b. For electronic mail CESAJ-ComplyDocs@usace.army.mil (not to exceed 10 MB). The Permittee shall reference this permit number, SAJ-2012-01719 (SP-AAZ) on all submittals.

3. Commencement Notification: Within 10 days from the date of initiating the authorized work, the Permittee shall provide a written notification of the date of commencement of authorized work to the Corps.

4. As-Built: Within 60 days of completion of the work authorized by this permit, the Permittee shall submit as-built drawings of the authorized work and a completed "As-Built Certification by Professional Engineer" form (Attachment 2) to the Corps. The as-built drawings shall be signed and sealed by a registered professional engineer and include the following:

a. A plan view drawing of the location of the authorized work footprint with an overlay of the work as constructed in the same scale as the attached permit drawings (8½-inch by 11-inch). The drawing should show all "earth disturbance," the aerial extent of disturbances, Global Positioning System (GPS) coordinates on the start and termination of disturbances, including wetland impacts, water management structures, and any on-site mitigation areas. Documentation will need to include a certification that the work was completed in accordance with the specifications, supporting field reports, GPS readings for the limits of the work performed, as-built drawings, and the date the work was complete.

b. List any deviations between the work authorized by this permit and the work as constructed. In the event that the completed work deviates, in any manner, from the authorized work, describe on the As-Built Certification Form the deviations between the work authorized by this permit and the work as constructed. Clearly indicate on the as-built drawings any deviations that have been listed. Please note that the depiction and/or description of any deviations on the drawings and/or As-Built Certification Form does not constitute approval of any deviations by the Corps.

c. The Department of the Army (DA) Permit number.

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d. Include pre- and post-construction aerial photographs of the project site, if available.

Mail the As-Built drawings to the Regulatory Division, Attn: Jose Rivera, Special Projects and Enforcement Branch, 4400 PGA Boulevard, Suite 500, Palm Beach Gardens, Florida 33410.

5. Agency Changes/Approvals: Should any other agency require and/or approve changes to the work authorized or obligated by this permit, the Permittee is advised a modification to this permit instrument is required prior to initiation of those changes. It is the Permittee's responsibility to request a modification of this permit from the Palm Beach Gardens Permits Section. The Corps reserves the right to fully evaluate, amend, and approve or deny the request for modification of this permit.

6. Assurance of Navigation and Maintenance: The Permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structures or work herein authorized, or if in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the Permittee will be required, upon due notice from the Corps, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

7. Turbidity Barriers: Prior to the initiation of any of the work authorized by this permit and where feasible, the Permittee shall install floating turbidity barriers with weighted skirts that extend to within one foot of the bottom around all work areas that are in, or adjacent to, surface waters. The turbidity barriers shall remain in place and be maintained until the authorized work has been completed and all suspended and erodible materials have been stabilized. Turbidity barriers shall be removed upon stabilization of the work area.

8. Hopper Dredging: The permit does not authorize the use of hopper dredge.

9. Dredge Vessels: The Permittee agrees to utilize a shallow draft barge with a fully loaded draft of no more than 8 feet. All vessels shall operate within waters of sufficient depth (one-foot clearance from the deepest draft of the vessel to the top of submerged resources or submerged bottom, whichever is less) in a manner to preclude bottom scarring, prop dredging, or damage to the submerged resource or bottom.

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10. Erosion Control: Prior to the initiation of any work authorized by this permit, the Permittee shall install erosion control measures along the perimeter of all upland work areas to prevent the displacement of fill material outside the work area from the spoil management area, including the staging areas, into waters of the United States. Immediately after completion of the final grading of the land surface, all slopes, land surfaces, and filled areas shall be stabilized using sod, degradable mats, barriers, or a combination of similar stabilizing materials to prevent erosion. The erosion control measures shall remain in place and be maintained until all authorized work is completed and the work areas are stabilized.

11. Dredged Material Disposal: The Permittee shall place all dredged material in the self-contained, upland disposal site at the Peanut Island DMMA. The Permittee shall maintain the DMMA to prevent the discharge of dredged material into waters of the United States.

12. Staging area: All staging areas, including any storage, stockpile of material, and construction equipment/tools shall be limited to upland areas and maintained in a manner that would prevent erosion within the ICW.

13. Biological Opinion: This Corps permit does not authorize you to take an endangered species, in particular Johnson's seagrass. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (ESA) [e.g., an ESA Section 10 permit, or a Biological Opinion (BO) under ESA Section 7, with "incidental take" provisions with which you must comply]. The enclosed National Marine Fisheries Service (NMFS) BO (Attachment 3) dated August 13, 2014, contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the BOs. Authorization under this Corps permit is conditional upon compliance with all of the mandatory terms and conditions associated with incidental take of the attached BOs, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the BOs, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute non-compliance with this Corps permit.

14. Manatee Conditions:

a. **Standard Manatee Conditions:** For all in-water activities, the Permittee shall comply with the 2011 "Standard Manatee Conditions for In-Water Work" provided in Attachment 4 of this permit.

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b. **Blasting Plan:** If seeking authorization to conduct blasting activities, the Permittee is responsible for submitting a Blasting Plan to the Corps for approval prior to implementing the blasting activities. The Blasting Plan must include the following components: 1) Blasting Design, 2) Impact Assessment, 3) Mitigation Plan, and 4) Endangered Species Watch Plan. In addition, confined blasting activities will only take place during daylight hours and will not take place between November 15 and March 31 of any year. The plan must be approved by the Corps and the U.S. Fish and Wildlife Service (USFWS) before blasting would occur.

c. **Clamshell Restrictions:** The use of a clamshell dredge will be prohibited at night throughout the year.

d. **Backhoe/Excavator Restrictions:** Backhoe/excavator dredging activities will be permitted to take place 24 hours per day, except between November 15 and March 31, during which time these dredging activities will only be permitted during daylight hours.

e. **Hydraulic dredge:** Hydraulic dredging activities will be permitted to take place 24 hours per day throughout the year.

f. **Manatee Protection Plan:** All other Federal, state and local protection measures outlined in the 2007 Palm Beach County Manatee Protection Plan will be executed.

g. **Reporting:** In the event a manatee is injured during construction activities, all activities will be terminated immediately, and the dedicated manatee observed as outlined in *The Standard Manatee Conditions for In-Water Work* (FWC 2011) will contact the USFWS, Florida Fish and Wildlife Conservation Commission (FFWCC), and the Corps no less than 12 hours after the discovery. All work shall cease until written or verbal notification from the USFWS is given to proceed. The USFWS address is:

U.S. Fish and Wildlife Service
Attn: Jeffrey Howe
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960
(772) 562-3909

15. Sea Turtle and Smalltooth Sawfish Conditions: The Permittee shall comply with National Marine Fisheries Service's "Sea Turtle and Smalltooth Sawfish Construction Conditions" dated March 23, 2006 and provided in Attachment 5 of this permit.

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16. Cultural Resources/Historic Properties:

a. No structure or work shall adversely affect impact or disturb properties listed in the National Register of Historic Places (NRHP) or those eligible for inclusion in the NRHP.

b. If during the ground disturbing activities and construction work within the permit area, there are archaeological/cultural materials encountered which were not the subject of a previous cultural resources assessment survey (and which shall include, but not be limited to: pottery, modified shell, flora, fauna, human remains, ceramics, stone tools or metal implements, dugout canoes, evidence of structures or any other physical remains that could be associated with Native American cultures or early colonial or American settlement), the Permittee shall immediately stop all work in the vicinity and notify the Corps. The Corps shall then notify the Florida State Historic Preservation Officer (SHPO) and the appropriate Tribal Historic Preservation Officer(s) (THPO(s)) to assess the significance of the discovery and devise appropriate actions.

c. A cultural resources assessment may be required of the permit area, if deemed necessary by the SHPO, THPO(s), or Corps, in accordance with 36 CFR 800 or 33 CFR 325, Appendix C (5). Based, on the circumstances of the discovery, equity to all parties, and considerations of the public interest, the Corps may modify, suspend or revoke the permit in accordance with 33 CFR Part 325.7. Such activity shall not resume on non-federal lands without written authorization from the SHPO and the Corps.

d. In the unlikely event that unmarked human remains are identified on non-federal lands, they will be treated in accordance with Section 872.05 Florida Statutes. All work in the vicinity shall immediately cease and the Permittee shall immediately notify the medical examiner, Corps, and State Archeologist. The Corps shall then notify the appropriate SHPO and THPO(s). Based, on the circumstances of the discovery, equity to all parties, and considerations of the public interest, the Corps may modify, suspend or revoke the permit in accordance with 33 CFR Part 325.7. Such activity shall not resume without written authorization from the State Archeologist, SHPO and the Corps.

17. Measures for safe navigation: The Permittee shall be required to submit a Maintenance of Marine Traffic Plan to the Corps at least two weeks prior to dredging activities. This plan is to be approved by the Corps prior to the commencement of construction and must clearly demonstrate how the contractor will avoid disruption of ongoing traffic to the maximum extent possible.

18. Compensatory Seagrass Mitigation: The Corps acknowledges that the 5.82 acres seagrass impacts authorized in this permit shall be compensated through utilization of credits at the Snook Island Natural Area. The Corps conducted a Habitat

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Equivalency Analysis (or HEA), which determined that 5.12 acres of seagrass habitat at Snook Island Natural Area is the needed compensation to offset the loss of 5.82 acres of seagrasses within the ICW Channel. Forthcoming to this permit, a modification to the DA permit SAJ-2000-02515 issued to the Palm Beach County for the creation of Snook Island Natural Area will deduct 5.12 seagrass acres from the ledger.

19. Compensatory Reef Mitigation: Within 12 months from the date of initiating the work authorized by this permit, the Permittee shall complete all construction and implementation mitigation activities for construction of the artificial reef at the Sugar Sands Artificial Reef area in accordance with the approved final compensatory mitigation plan included as Attachment 6 of this permit.

20. Initial Agency Notification: The Permittee shall provide to the Corps, National Oceanic and Atmospheric Administration (NOAA), and U.S. Coast Guard (USCG) written notification of the planned deployment start date at least 2 weeks prior to the initial deployment on the authorized artificial reef site. The address for NOAA and USCG is as follows:

- a. National Oceanic and Atmospheric Administration
Marine Chart Division
Office of Coast Survey, N/CS26, Sta. 7317
1315 East-West Highway
Silver Springs, MD 20910-3282

or email at ocs.ndb@noaa.gov

- b. Commander, U.S. Coast Guard
Sector Miami
Attn: Lieutenant Art Loughran
100 MacArthur Causeway
Miami Beach, Florida 33139

or email at Arthur.F.Loughran@uscg.mil

21. Authorized Reef Materials: No reef materials or module will weigh less than 500 pounds. Reef materials shall be clean and free from asphalt, petroleum, other hydrocarbons and toxic residues, loose free floating material or other deleterious substances. All artificial reef materials and/or structures will be selected, designed, constructed, and deployed to create stable and durable marine habitat. The Permittee shall deploy only the following authorized reef materials:

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a. Prefabricated artificial reef modules composed of ferrous and/or aluminum-alloy metals, ¼ inch or more in thickness, concrete, rock, or a combination of these materials.

b. Natural rock boulders and other pre-cast concrete material such as culverts, stormwater junction boxes, power poles, railroad ties, jersey barriers, or other similar concrete material.

c. Clean steel and concrete bridge or large building demolition materials such as slabs or pilings with all steel reinforcement rods severed as close to the concrete surface as possible but not to extend more than 6 inches to ensure the rod will not create a fishing tackle or diver ensnaring hazard.

d. Heavy gauge ferrous & aluminum alloy metal material components or structures, ¼ inch or more in thickness, such as utility poles and antenna towers.

e. Heavy gauge ferrous and aluminum alloy metal hulled vessels which equal or exceed 60 feet hull length prepared and deployed in accordance with all applicable USCG, U.S. Environmental Protection Agency, FFWCC, or other applicable state or federal agency regulations or policies. The vessel shall not be deployed until all necessary inspections and clearances have been obtained or waived and a stability analysis has been completed demonstrating the vessel will be stable during a 50-year storm event based on vessel and deployment site characteristics. The Permittee shall follow the National guidance regarding preparation of vessels for deployment as artificial reefs which are available at:
<http://www.epa.gov/owow/oceans/habitat/artificialreefs/index.html>. The Permittee shall provide a record of all inspections, clearances or waivers to the Corps along with the pre-deployment notification.

REEF PARAMETERS

22. Reef Parameters: The Permittee shall deploy all reef materials within the site boundaries conforming to the standards for artificial reef substrate in the FFWCC recommended: **Guidelines for Marine Artificial Reef Materials 2nd Edition** accessible at:

http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_2004.pdf

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23. Violation of Reef Parameters Notification: In the event reef material is deployed in a location or manner contrary to the Reef Parameters Special Condition, the Permittee shall immediately notify the USCG Station and provide information as requested by the station. The Permittee shall notify NOAA, USCG and Corps in writing within 24 hours of the occurrence. At a minimum the written notification shall explain how the deployed material exceeds the authorized reef parameters, a description of the material, a description of the vessel traffic in the area, the deployment location in nautical miles at compass bearing from obvious landmarks, the location of the unauthorized material in latitude and longitude coordinates (degree, minute, decimal minute format to the third decimal place), and the water depth above the material from mean low water. The document will list the information provided by telephone to the USCG as noted above and include the time of the call and the name of the USCG personnel receiving the information.

24. Protection of Existing Resources: The Permittee shall not deploy artificial reef materials until an assessment of the bottom conditions have been accomplished by diver, submersible video camera, fathometer, depth/bottom sounder (e.g. “fish finder”), or side-scan sonar. The inspection of the deployment area may occur at the time of deployment, but no more than 1 year prior to deployment. The Permittee shall maintain a deployment buffer of at least 75 feet from any submerged beds of sea grasses, coral reefs, live bottom, areas supporting growth of sponges, sea fans, soft corals, and other sessile macroinvertebrates generally associated with rock outcrops, oyster reefs, scallop beds, clam beds, or areas where there are unique or unusual concentrations of bottom-dwelling marine organisms. Should the assessment find any evidence of cultural/archaeological resources such as sunken vessels, ballast, historic refuse piles, or careenage areas, the Permittee shall also maintain a deployment buffer of at least 75 feet from these resources.

The Permittee shall provide of the information obtained from the assessment to the Corps no less than 14 days prior to deployment of material on an artificial reef in conjunction with the pre-deployment notification.

DEPLOYMENT

25. Ownership/Maintenance/Liability: By signing this permit, the Permittee certifies and acknowledges ownership of all artificial reef materials deployed on the reef, accepts responsibility for maintenance of the artificial reef, and possesses the ability to assume liability for all damages that may arise with respect to the artificial reef.

These onsite compensatory mitigation areas shall be preserved in accordance with the existing land use approval. If a change in land use is proposed or the property is

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otherwise managed in a manner inconsistent with the compensatory mitigation required for the permit, the Permittee must provide alternative compensatory mitigation within 60 days of the proposed change.

26. Marine Life Entrapment: Neither reef structure nor material or the method of design or deployment should pose more than minimal risk of entrapping fish, marine turtles, or marine mammals. The Permittee shall take all necessary action to minimize this risk. Any observation of entrapped marine turtles or marine mammals on this artificial reef site should be reported immediately to the Enforcement Section by telephone at 561-472-3536 and the National Marine Fisheries Service by telephone at 727-824-5301

27. Update of Nautical Charts: The Permittee shall notify, within 90 days of construction completion, NOAA, Nautical Data Branch N/CS26, Station 7313, 1315 East-West Highway, Silver Spring, MD 20910-3282 so that the navigation charts can be updated to reflect the changes in channel depths. The information to be submitted shall include “as-built plans,” signed and sealed by a registered surveyor/engineer licensed in the State of Florida. The signed and sealed plans shall certify that the project is constructed as authorized and must include an accurate (within plus or minus 1 foot) depiction of the location and configuration of the completed activity in relation to the mean high water of the navigable water.

28. Notice to Mariners: Within 30 days of completion of the project, FIND will issue a notice to mariners and notify the adjacent marinas of the location of the deeper channel and the specific one-way traffic requirements.

29. Reporting Format: Annual monitoring reports shall follow a 20-page maximum report format for assessing compensatory mitigation sites. The Permittee shall submit all documentation to the Corps on 8½-inch by 11-inch paper, and include the following:

- a. Project Overview (1 Page):
 - (1) Department of the Army Permit Number
 - (2) Name and contact information of Permittee and consultant
 - (3) Name of party responsible for conducting the monitoring and the date(s) the inspection was conducted

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(4) A brief paragraph describing the purpose of the approved project, acreage and type of aquatic resources impacted, and mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts.

(5) Written description of the location, any identifiable landmarks of the compensatory mitigation project including information to locate the site perimeter(s), and coordinates of the mitigation site (expressed as latitude, longitudes, UTM's, state plane coordinate system, etc.).

(6) Dates compensatory mitigation commenced and/or was completed

(7) Short statement on whether the performance standards are being met

(8) Dates of any recent corrective or maintenance activities conducted since the previous report submission

(9) Specific recommendations for any additional corrective or remedial actions.

b. Requirements (1 page): List the monitoring requirements and performance standards, as specified in the approved mitigation plan and special conditions of this permit, and evaluate whether the compensatory mitigation project site is successfully achieving the approved performance standards or trending towards success. A table is a recommended option for comparing the performance standards to the conditions and status of the developing mitigation site.

c. Summary Data (maximum of 4 pages): Summary data should be provided to substantiate the success and/or potential challenges associated with the compensatory mitigation project. Photo documentation may be provided to support the findings and recommendations referenced in the monitoring report and to assist the PM in assessing whether the compensatory mitigation project is meeting applicable performance standards for that monitoring period. Submitted photos should be formatted to print on a standard 8 ½" x 11" piece of paper, dated, and clearly labeled with the direction from which the photo was taken. The photo location points should also be identified on the appropriate maps.

d. Maps and Plans (maximum of 3 pages): Maps shall be provided to show the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transects, sampling data points, and/or other features pertinent to the mitigation plan. In addition, the submitted maps and plans should clearly delineate the mitigation site perimeter(s). Each map or diagram should be formatted to print on a standard 8 ½" x 11" piece of paper and

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include a legend and the location of any photos submitted for review. As-built plans may be included.

e. Conclusions (1 page): A general statement shall be included that describes the conditions of the compensatory mitigation project. If performance standards are not being met, a brief explanation of the difficulties and potential remedial actions proposed by the Permittee or sponsor, including a timetable, shall be provided. The District Commander will ultimately determine if the mitigation site is successful for a given monitoring period.

30. Mitigation Release: The Permittee's responsibility to complete the required compensatory mitigation, as set forth in the **Compensatory Reef Mitigation** Special Condition of this permit will not be considered fulfilled until mitigation success has been demonstrated and written verification has been provided by the Corps. A mitigation area which has been released will require no further monitoring or reporting by the Permittee; however the Permittee, Successors and subsequent Transferees remain perpetually responsible to ensure that the mitigation area(s) remain in a condition appropriate to offset the authorized impacts in accordance with General Condition 2 of this permit.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)

Section 404 of the Clean Water Act (33 U.S.C. 1344)

Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413)

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

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d. This permit does not authorize interference with any existing or proposed Federal projects.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

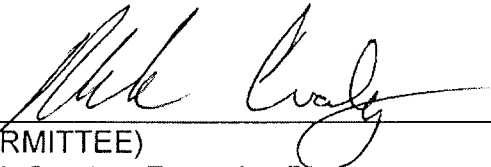
Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you comply with the terms and conditions of your permit and for the initiation of

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legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

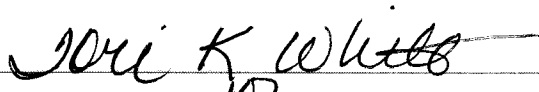


(PERMITTEE)
Mark Crosley, Executive Director
Florida Inland Navigation District

12/16/14
(DATE)

(PERMITTEE NAME-PRINTED)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.



(DISTRICT ENGINEER)
Alan M. Dodd,
Colonel, U.S. Army
District Commander

17 December 2014
(DATE)

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When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFeree-SIGNATURE)

(DATE)

(NAME-PRINTED)

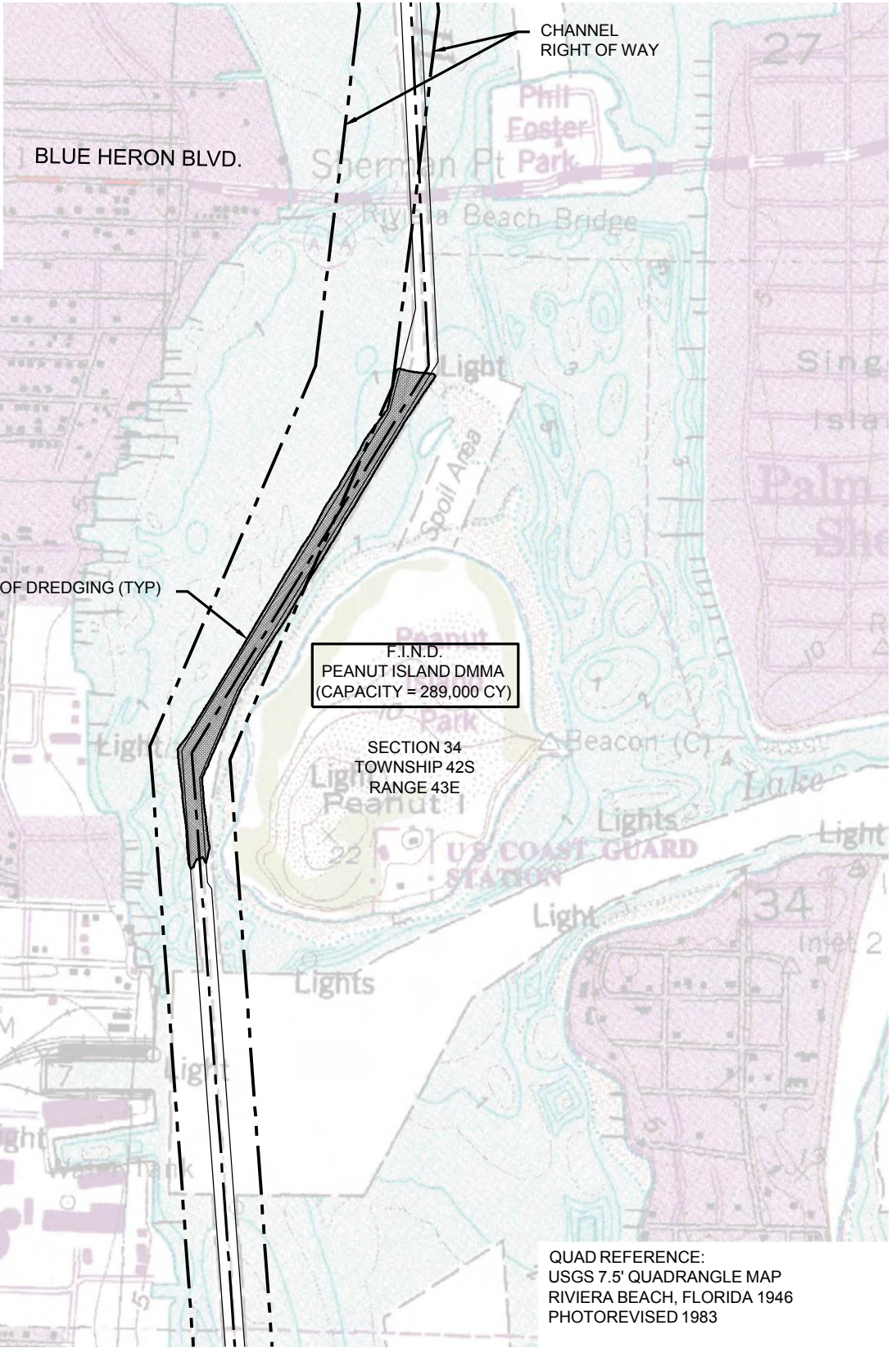
(ADDRESS)

(CITY, STATE, AND ZIP CODE)

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***Attachments to Department of the Army
Permit Number SAJ-2012-01719 (SP-AAZ)***

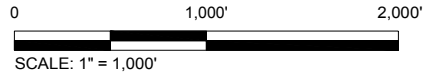
1. ICW DREDGING DESIGN PLANS: Eleven (11) pages
2. AS-BUILT CERTIFICATION FORM: Two (2) pages
3. BIOLOGICAL OPINION: NMFS Biological opinion for Johnson's seagrass dated August 13, 2014, thirty-three (33) pages
4. STANDARD MANATEE CONDITIONS FOR IN-WATER WORK: Two (2) pages dated 2011
5. SEA TURTLE AND SMALLTOOTH SAWFISH CONDITIONS: One (1) page dated March 23, 2006
6. 12 COMPONENTS OF A MITIGATION PLAN FOR THE SUGAR SANDS ARTIFICIAL REEF AREA: Thirteen (13) pages
7. WATER QUALITY CERTIFICATION: Specific Conditions of the water quality permit/certification in accordance with General Condition number 5 on page 2 of this permit: Eight (8) pages



F.I.N.D.
 PEANUT ISLAND DMMA
 (CAPACITY = 289,000 CY)

SECTION 34
 TOWNSHIP 42S
 RANGE 43E

QUAD REFERENCE:
 USGS 7.5' QUADRANGLE MAP
 RIVIERA BEACH, FLORIDA 1946
 PHOTOREVISED 1983



NOTE:
 PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT
 MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

CATRYN SHELL X:\SIS\PROJECTS\2011-088 ICWW DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-088B-P-LOCATION MAP.DWG 2/5/2013 1:17:19 PM

TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300

FIGURE E1
 LOCATION MAP
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

SEAL

JACKSONVILLE, FL 32256

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	1 of 11	FEB 2013

PROJECT SUMMARY

CUT LENGTH	3,555 FT
PROJECT AREA	12.24 AC
	532,963 SF
DREDGE VOLUME	95,580 CY

PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009.
2. BATHYMETRIC SURVEY: USACE, AUGUST 2010 INTRACOASTAL WATERWAY; JACKSONVILLE TO MIAMI, FLORIDA; CUTS P-34 THRU P-39 & P-52 THRU P-59; EXAMINATION SURVEY FY10; 10-FOOT PROJECT (10-113).
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



CATHY SHELL X:\SYSTEMS\PROJECTS\2011-068 (CWM) DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-068-P-PROJECT OVERVIEW.DWG 2/5/2013 1:17:26 PM

TAYLOR ENGINEERING INC.

10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E2
PROJECT OVERVIEW
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

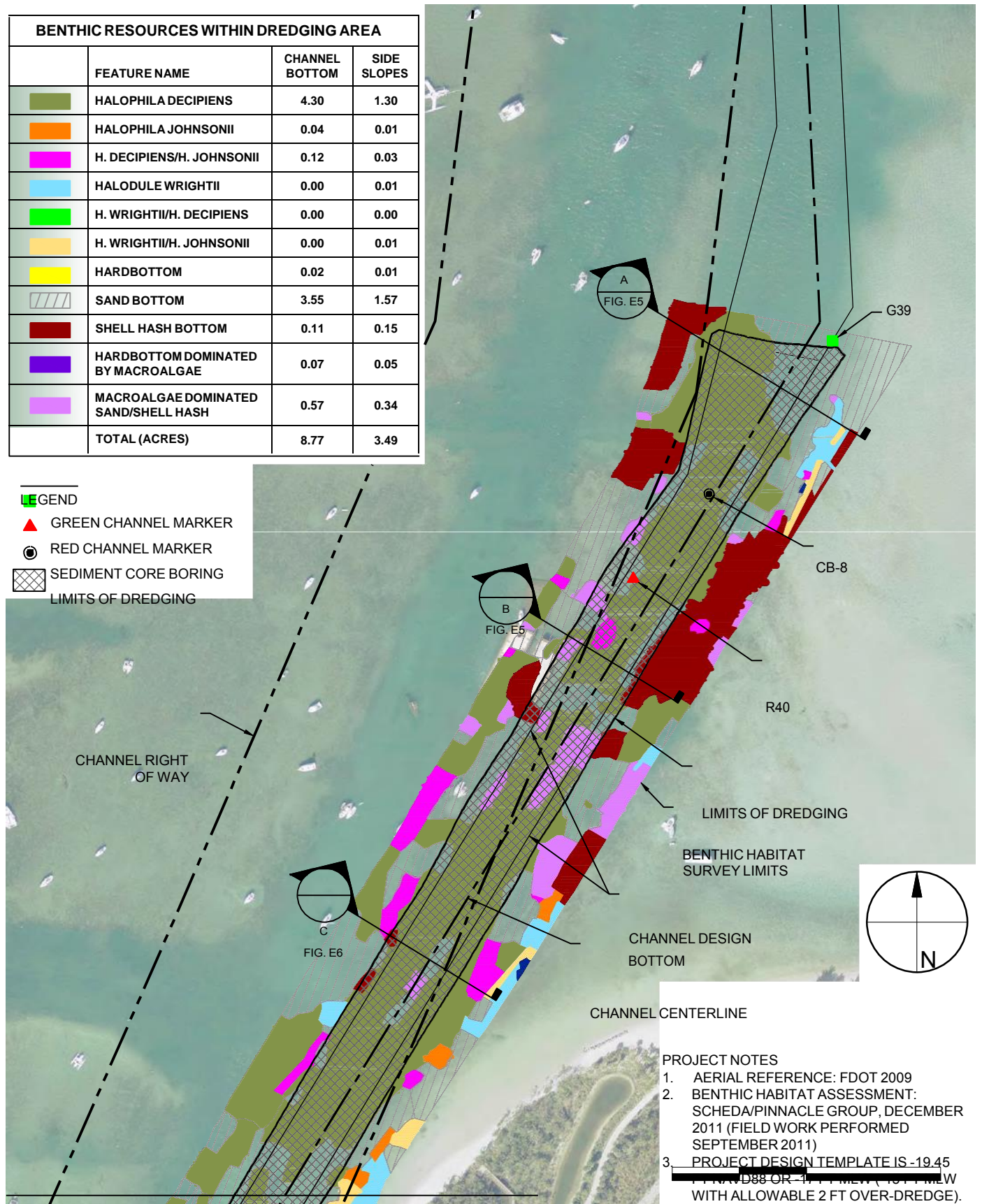
PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	2 of 11	FEB 2013

LORI S. BROWNELL P.E.# 60025

DATE

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

- LEGEND**
- GREEN CHANNEL MARKER
 - RED CHANNEL MARKER
 - SEDIMENT CORE BORING LIMITS OF DREDGING



- PROJECT NOTES**
- AERIAL REFERENCE: FDOT 2009
 - BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
 - PROJECT DESIGN TEMPLATE IS -19.45
~~PLAN D88 OR 4.1.1 WITH 10.7 FEET W~~
 WITH ALLOWABLE 2 FT OVER-DREDGE).



MATCHLINE A

CATHY SHELL X:\S\PROJECT\SIC2011-088\C\DW\DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\C2011-088-P-DREDDGE PLAN.DWG 2/2/2013 1:17:35 PM

TAYLOR ENGINEERING INC.

10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E3A (WITH AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
(NORTH)
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	3 of 11	FEB 2013

LORI S. BROWNELL P.E.# 60025

DATE

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

- LEGEND**
- GREEN CHANNEL MARKER
 - RED CHANNEL MARKER
 - SEDIMENT CORE BORING LIMITS OF DREDGING

CHANNEL RIGHT OF WAY

LIMITS OF DREDGING

BENTHIC HABITAT SURVEY LIMITS

CHANNEL DESIGN BOTTOM

CHANNEL CENTERLINE

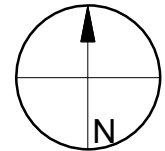
PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
3. PROJECT DESIGN TEMPLATE IS -19.45
 WITH ALLOWABLE 2 FT OVER-DREDGE).

0 250' 500'

SCALE: 1" = 250'

MATCHLINE A



G39

CB-8

R40

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CATHY SHELL X:\S\PROJECT\S\2011-08\ICW\DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-08\P-DREDDGE PLAN.DWG

TAYLOR ENGINEERING INC.

10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E3B (WITHOUT AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
(NORTH)
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	4 of 11	FEB 2013

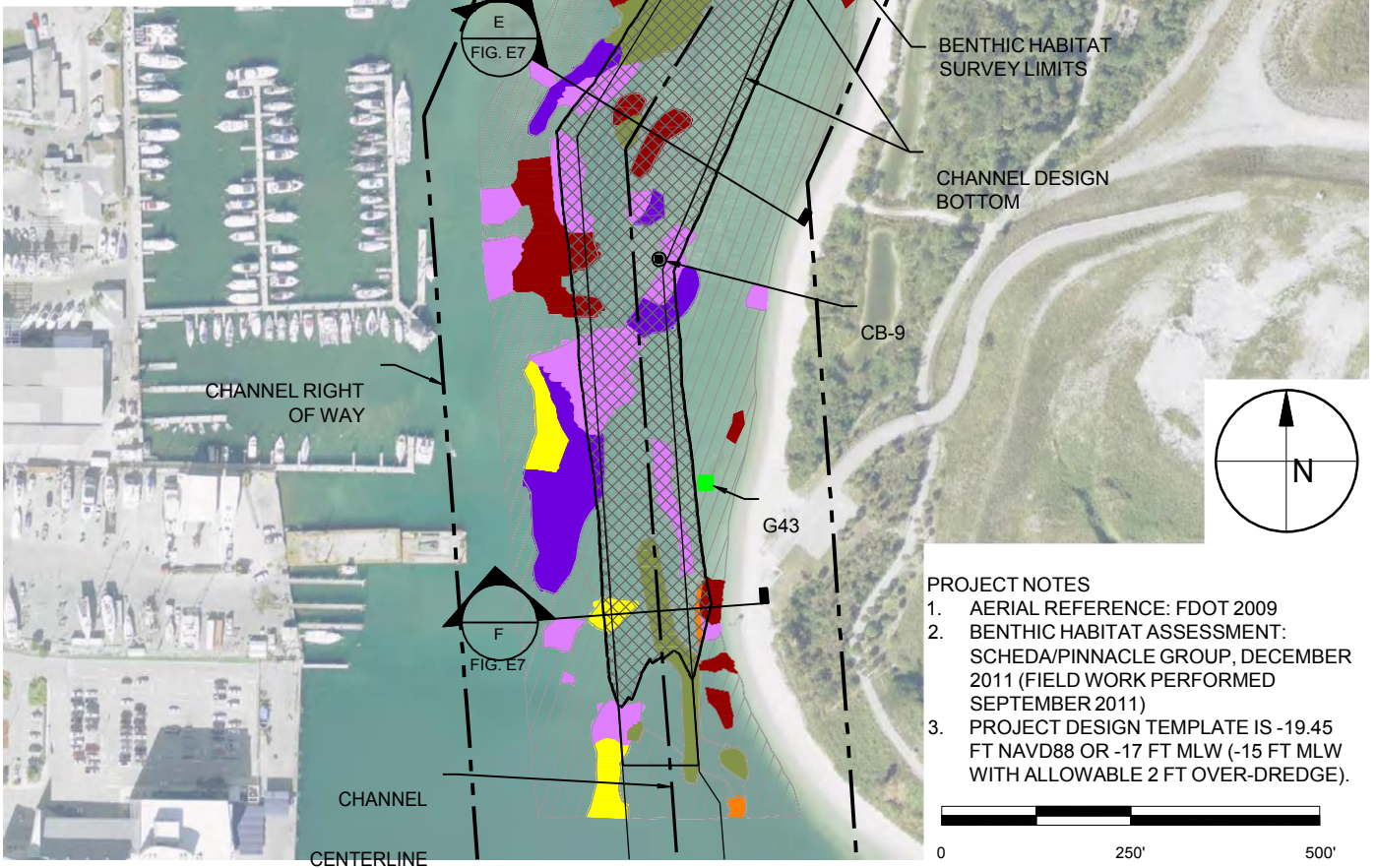
LORI S. BROWNELL P.E.# 60025

DATE

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

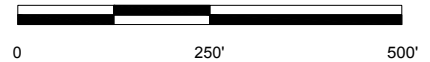
LEGEND

- GREEN CHANNEL MARKER
- RED CHANNEL MARKER
- SEDIMENT CORE BORING
- LIMITS OF DREDGING



PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



SCALE: 1" = 250'

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10151 DEERWOOD PARK BLVD.
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JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E4A (WITH AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
(SOUTH)
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	5 of 11	FEB 2013

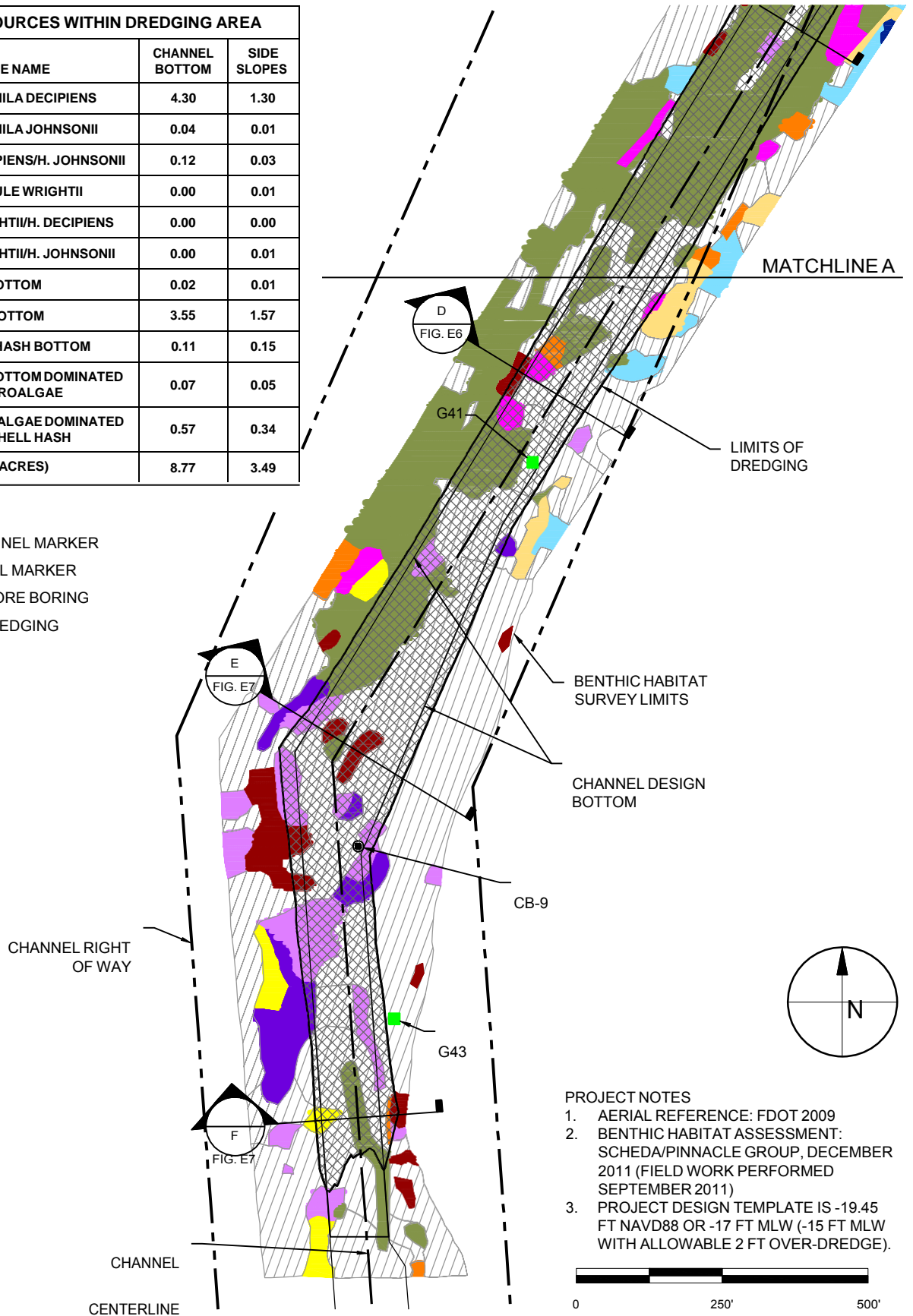
LORI S. BROWNELL P.E.# 60025

DATE

BENTHIC RESOURCES WITHIN DREDGING AREA			
	FEATURE NAME	CHANNEL BOTTOM	SIDE SLOPES
	HALOPHILA DECIPIENS	4.30	1.30
	HALOPHILA JOHNSONII	0.04	0.01
	H. DECIPIENS/H. JOHNSONII	0.12	0.03
	HALODULE WRIGHTII	0.00	0.01
	H. WRIGHTII/H. DECIPIENS	0.00	0.00
	H. WRIGHTII/H. JOHNSONII	0.00	0.01
	HARDBOTTOM	0.02	0.01
	SAND BOTTOM	3.55	1.57
	SHELL HASH BOTTOM	0.11	0.15
	HARDBOTTOM DOMINATED BY MACROALGAE	0.07	0.05
	MACROALGAE DOMINATED SAND/SHELL HASH	0.57	0.34
	TOTAL (ACRES)	8.77	3.49

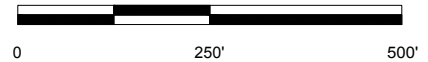
LEGEND

- GREEN CHANNEL MARKER
- RED CHANNEL MARKER
- SEDIMENT CORE BORING
- LIMITS OF DREDGING



PROJECT NOTES

1. AERIAL REFERENCE: FDOT 2009
2. BENTHIC HABITAT ASSESSMENT: SCHEDA/PINNACLE GROUP, DECEMBER 2011 (FIELD WORK PERFORMED SEPTEMBER 2011)
3. PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).



SCALE: 1" = 250'

TAYLOR ENGINEERING INC.

10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

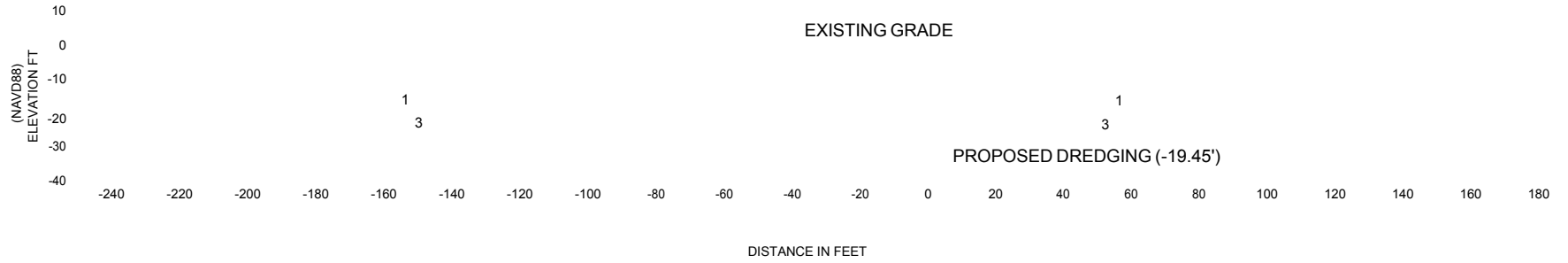
FIGURE E4B (WITHOUT AERIAL)
BENTHIC RESOURCES WITHIN LIMITS OF DREDGING
(SOUTH)
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	6 of 11	FEB 2013

LORI S. BROWNELL P.E.# 60025

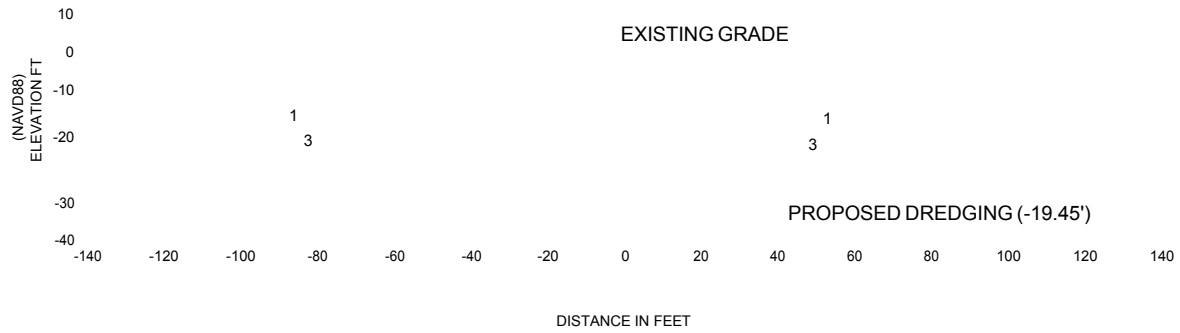
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A CHANNEL CUT - TYPICAL SECTION

FIG. E3 SCALE: 1" = 50'

V-SCALE: 1" = 50' 0 50'



B CHANNEL CUT - TYPICAL SECTION

FIG. E3 SCALE: 1" = 50'

V-SCALE: 1" = 50' 0 50'

DATUM REFERENCE

NAVD88

2.45'

MLW

0.15'

MLLW

DESIGN REFERENCE: NAVD88

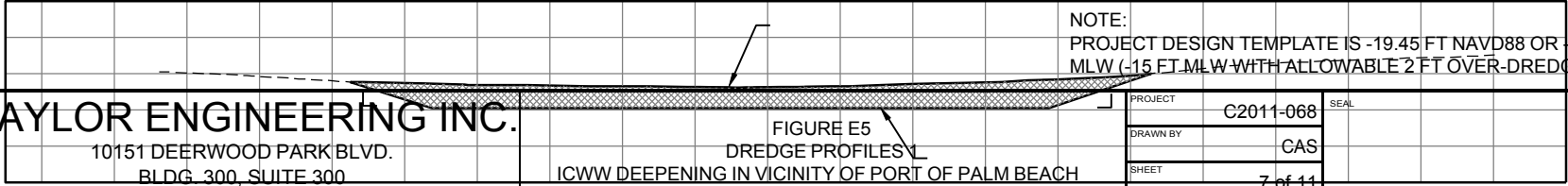
NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH

CONTROL TIDE STATION: 8721604 TRIDENT PIER, PORT
 CANAVERAL LENGTH OF SERIES: 9 MONTHS

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C:\GIS\PROJECTS\2011-08\ICW\DEEPENING PALM BEACH HARBOR PERMITS\FIGURES\2011-08\F-DREDGE PROFILES.DWG

TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008
 TIDAL EPOCH: 1983-2001

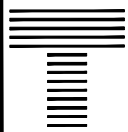
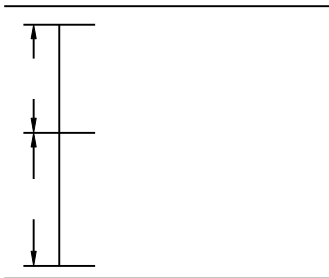
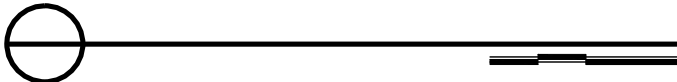
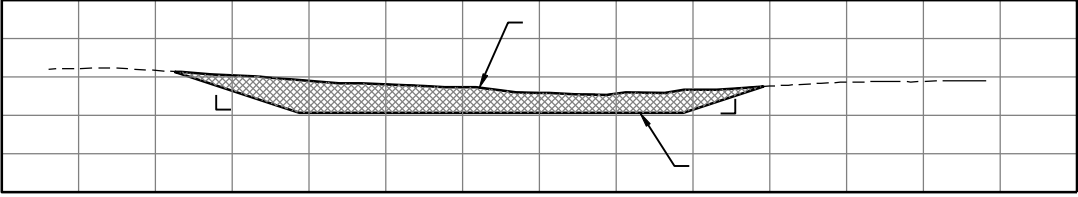
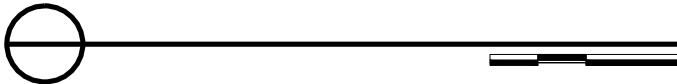


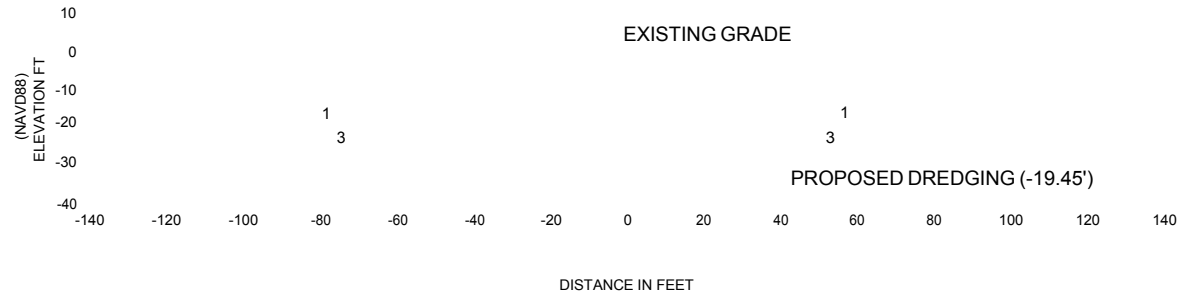
TAYLOR ENGINEERING INC.
 10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E5
 DREDGE PROFILES
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

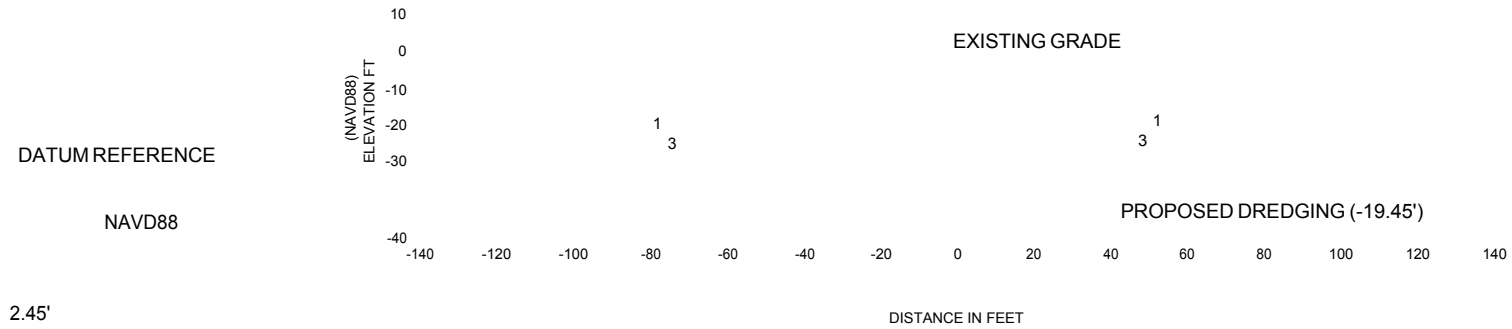
PROJECT	C2011-068	SEAL	
DRAWN BY	CAS		
SHEET	7 of 11		
DATE	FEB 2013		

LORI S. BROWNELL P.E.# 60025 DATE





C
 FIG. E3
 CHANNEL CUT - TYPICAL SECTION
 SCALE: 1" = 50'
 V-SCALE: 1" = 50'



DATUM REFERENCE

NAVD88

2.45'

MLW

0.15'

MLLW

DESIGN REFERENCE: NAVD88

NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH
 CONTROL TIDE STATION: 8721604 TRIDENT PIER, PORT CANAVERAL

LENGTH OF SERIES: 9 MONTHS
 TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008
 TIDAL EPOCH: 1983-2001

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PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

NOTE:

TAYLOR ENGINEERING INC

10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

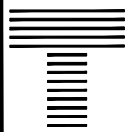
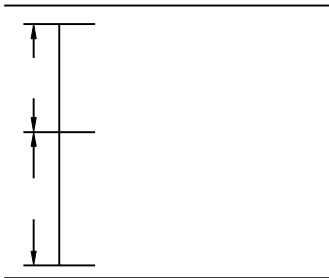
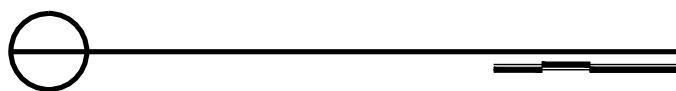
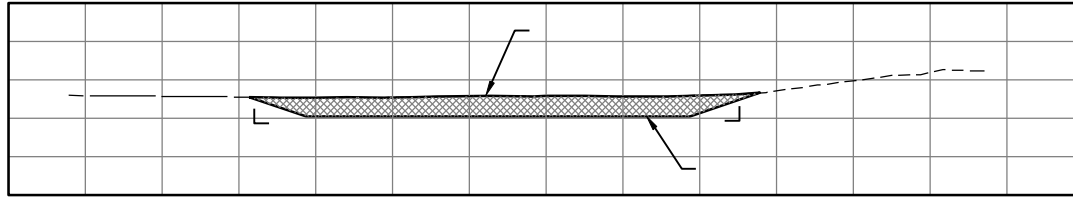
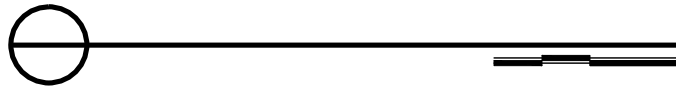
FIGURE E6
DREDGE PROFILES 2
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA

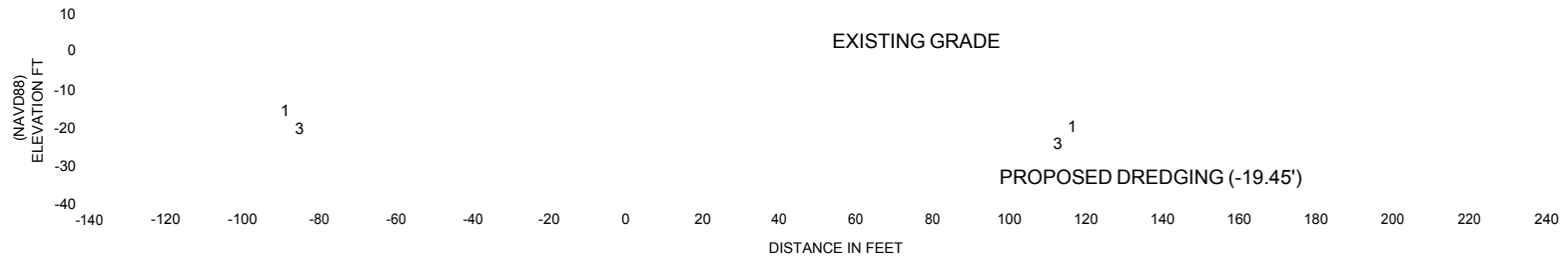
PROJECT	C2011-068
DRAWN BY	CAS
SHEET	8 of 11
DATE	FEB 2013

SEAL

LORI S. BROWNELL P.E.# 60025

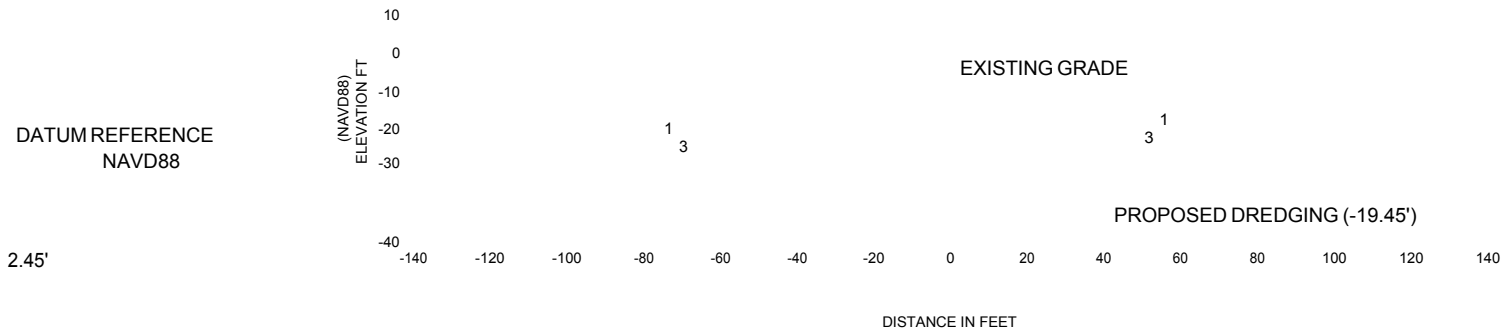
DATE





E CHANNEL CUT - TYPICAL SECTION
 FIG. E4 SCALE: 1" = 50'

V-SCALE: 1" = 50' 0 50'



F CHANNEL CUT - TYPICAL SECTION
 FIG. E4 SCALE: 1" = 50'

V-SCALE: 1" = 50' 0 50'

MLLW
 DESIGN REFERENCE: NAVD88

NOV. 2011 TIDAL DATUMS AT PORT OF W. PALM BEACH, LAKE WORTH
 CONTROL TIDE STATION: 8721604 TRIDENT PIER, PORT CANAVERAL
 LENGTH OF SERIES: 9 MONTHS
 TIME PERIOD: FEBRUARY 2008 - OCTOBER 2008

TIDAL EPOCH: 1983-2001

PROJECT DESIGN TEMPLATE IS -19.45 FT NAVD88 OR -17 FT MLW (-15 FT MLW WITH ALLOWABLE 2 FT OVER-DREDGE).

NOTE:

TAYLOR ENGINEERING INC.

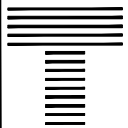
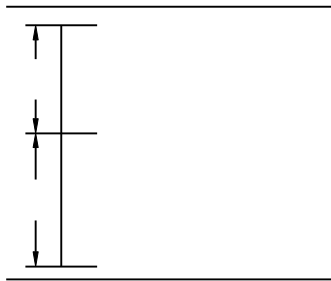
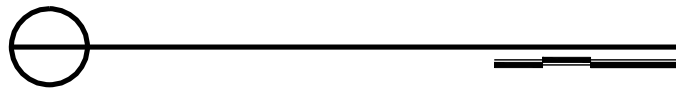
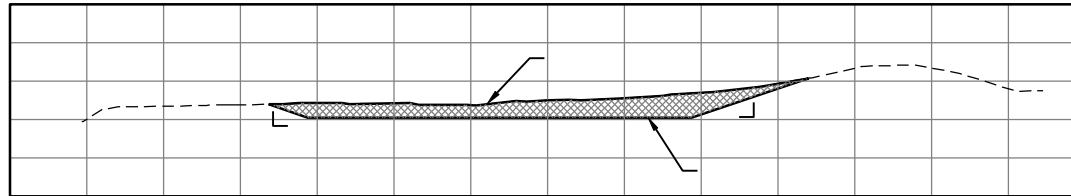
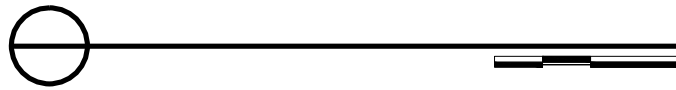
10151 DEERWOODS PARK BLVD
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E7
DREDGE PROFILES 3
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

PROJECT	C2011-068	SEAL
DRAWN BY	CAS	
SHEET	9 of 11	
DATE	FEB 2013	

LORI S. BROWNELL, P.E. # 40025

DATE





HELL X:\S\PROJECTS\2011-088 ICWW DEEPENING PALM BEACH HARBOR\PERMITS\FIGURES\2011-088-P-DMMA.DWG 2/5/2013 1:17:52 PM

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BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE E8
EXISTING F.I.N.D. PEANUT ISLAND DMMA
ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
PALM BEACH COUNTY, FLORIDA

SEAL

PROJECT	DRAWN BY	SHEET	DATE
C2011-068	CAS	10 of 11	FEB 2013

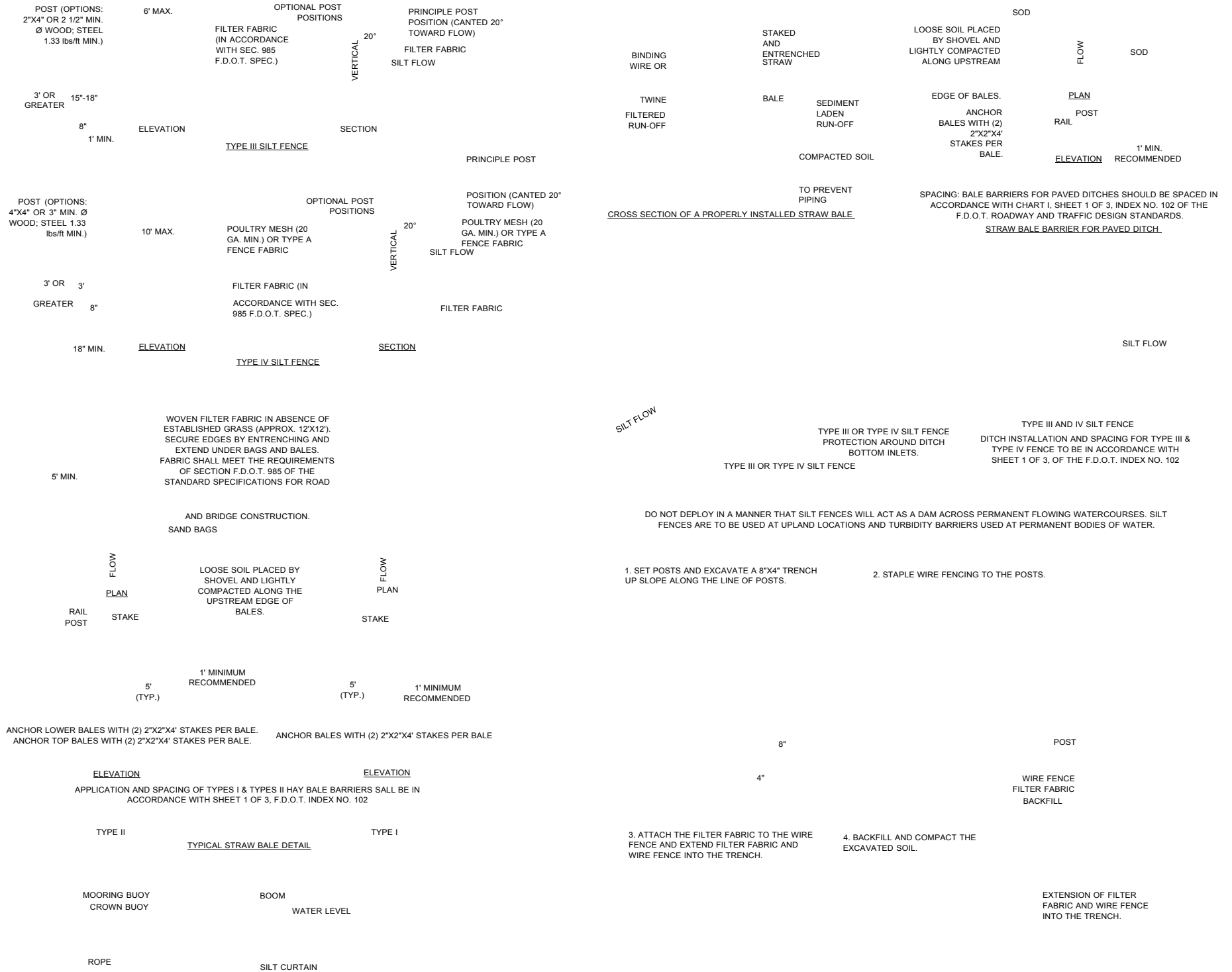
LORI S. BROWNELL P.E.# 60025

DATE

PRELIMINARY DRAWINGS: THESE DRAWINGS ARE NOT IN FINAL FORM, BUT ARE BEING TRANSMITTED FOR AGENCY REVIEW.

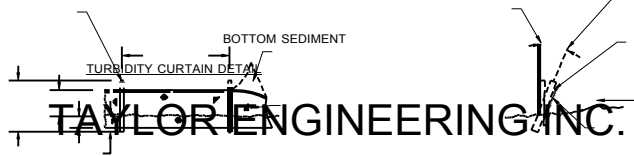
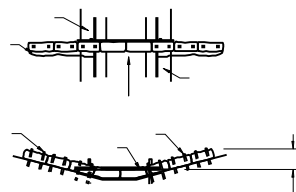
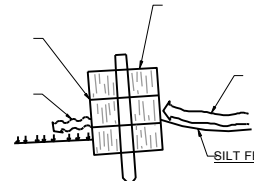
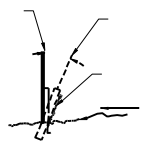
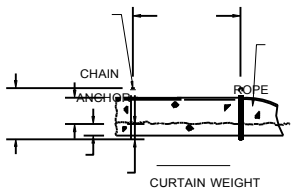
F 81

Section 1135 Lake Worth Lagoon - Ecosystem Restoration Project
LWL Past Permits – EN Attachment F



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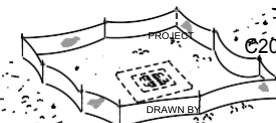
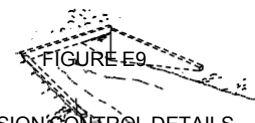
2011-088 ICWV DEEPENING PALM BEACH HARBOR PERMITS FIGURES/2011-088-P-EROSION.DWG



TAYLOR ENGINEERING, INC.

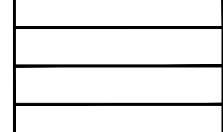
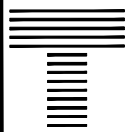
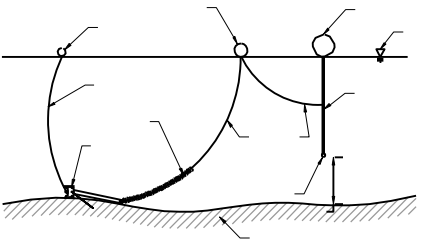
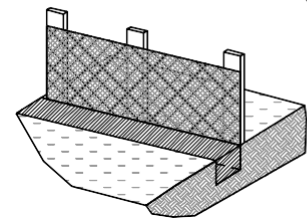
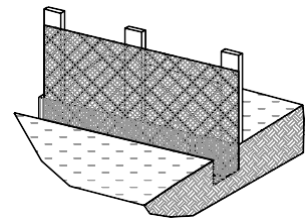
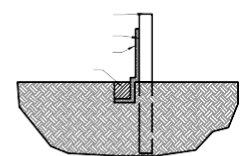
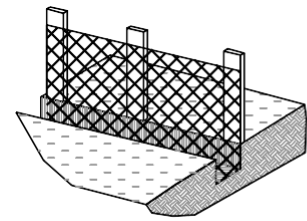
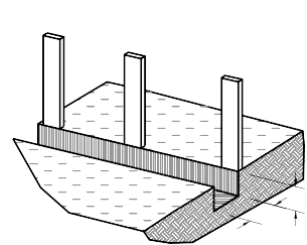
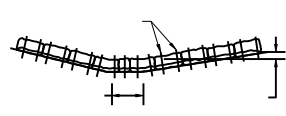
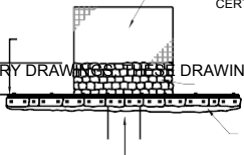
10151 DEERWOOD PARK BLVD.
 BLDG. 300, SUITE 300
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

EROSION CONTROL DETAILS
 ICWW DEEPENING IN VICINITY OF PORT OF PALM BEACH
 PALM BEACH COUNTY, FLORIDA



PROJECT: 2011-068
 DRAWN BY: CAS
 SHEET: 11 of 11
 DATE: FEB 2013
 LORI S. BROWNELL P.E.# 60025

PRELIMINARY DRAWINGS ARE NOT IN FINAL FORM, BUT ARE BEING TRANSMITTED FOR AGENCY REVIEW.



AS-BUILT CERTIFICATION BY PROFESSIONAL ENGINEER

Submit this form and one set of as-built engineering drawings to the U.S. Army Corps of Engineers, Enforcement Branch, Post Office Box 4970, Jacksonville, Florida 32232-0019. If you have questions regarding this requirement, please contact the Enforcement Branch at 904-232-2907.

1. Department of the Army Permit Number: _____

2. Permittee Information:

Name _____

Address _____

3. Project Site Identification:

Physical location/address _____

4. As-Built Certification:

I hereby certify that the authorized work, including any mitigation required by Special Conditions to the permit, has been accomplished in accordance with the Department of the Army permit with any deviations noted below. This determination is based upon on-site observation, scheduled and conducted by me or by a project representative under my direct supervision. I have enclosed one set of as-built engineering drawings.

Signature of Engineer

Name (Please type)

(FL, PR or VI) Reg. Number

Company Name

Address

City

State

ZIP

(Affix Seal)

Date

Telephone Number

-2-

**Deviations from the approved permit drawings and special conditions:
(attach additional pages if necessary)**



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
<http://sero.nmfs.noaa.gov>

F/SER31:KBD
SER-2013-11111
SER-2013-11594

Chief, Palm Beach Gardens Section
Jacksonville District, Corps of Engineers
Department of the Army
4400 PGA Boulevard, Suite 500
Palm Beach Gardens, Florida 33410

AUG 13 2014

Ref.: SAJ-2008-1808 (SP-AAZ), Rybovich RBYC, LLC; SAJ-2004-12508 (SP-AAZ), Rybovich West Palm Beach Facility; and SAJ-2012-01719 (SP-AAZ), Florida Inland Navigation District, Palm Beach County, Florida

Dear Sir or Madam:

The enclosed document constitutes the National Marine Fisheries Service's (NMFS's) Biological Opinion ("Opinion") based on our review of the U.S. Army Corps of Engineers (USACE), Jacksonville District's proposed action to issue a permit to RBYC, LLC for the modification of 2 existing docking facilities owned by Rybovich in Riviera Beach and West Palm Beach, Palm Beach County, Florida. USACE added Rybovich's West Palm Beach facility to the permit application because it would undergo modifications that are associated with the Riviera Beach facility. This Opinion also addresses a permit application for the Florida Inland Navigation District (FIND) for proposed deepening of the Intracoastal Waterway (ICW), located west of Peanut Island and adjacent to Riviera Beach facility's access channel. These projects are being addressed together in this Opinion since NMFS believes they are interrelated and interdependent. This Opinion is based on information provided in your letters dated October 14, 2011, June 25, 2012, March 27, 2013, and March 3, 2014, as well as supporting information supplied by the USACE, and information from previous NMFS consultations on Johnson's seagrass.

The proposed purpose of these projects is to modify Rybovich's 2 existing facilities in Palm Beach County so they can accommodate large megayachts that are in need of repair and to deepen the ICW between the 2 facilities so that safe passage can be provided to the deep-draft vessels. The Opinion analyzes the project's effects on Johnson's seagrass, smalltooth sawfish, and sea turtles, in accordance with Section 7 of the Endangered Species Act (ESA) of 1973. It is NMFS's Opinion that the action, as proposed, may affect, but is not likely to adversely affect, smalltooth sawfish or sea turtles. The action is likely, however, to adversely affect Johnson's seagrass, but is not likely to jeopardize its continued existence.

We look forward to further cooperation with you on other USACE projects to ensure the conservation and recovery of our threatened and endangered marine species and designated critical habitat. If you have any questions regarding this consultation, please contact Kay Davy, Consultation Biologist, by email at Kay.Davy@noaa.gov, or by phone at (727) 415-9271.

Sincerely,

Miles M. Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator



Endangered Species Act - Section 7 Consultation
Biological Opinion

Agency: United States Army Corps of Engineers, Jacksonville District (USACE)

Activity: Issuance of permits for the modification of two existing docking facilities owned by Rybovich in Riviera Beach and West Palm Beach (SER-2013-11594) and for Florida Inland Navigation District (FIND) to deepen a portion of the Intracoastal Waterway (ICW) that is located west of Peanut Island, Palm Beach County, Florida (SER-2013-11111)

Consulting Agency: National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida

NMFS Consultation No. SER-2013-11594 and SER-2013-11111

Approved By:

Miles M. Croom
for Roy E. Crabtree, Ph.D., Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

Date Issued:

AUG 13 2014

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
CFR	Code of Federal Regulations
cm	Centimeter
DPS	Distinct Population Segment
DMMA	Dredged Material Management Area
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	Degrees Fahrenheit
ft	Feet
FIND	Florida Inland Navigation District
FWC	Florida Fish and Wildlife Conservation Commission
ITS	Incidental Take Statement
ICW	Intracoastal Waterway
km	Kilometer
MLW	Mean Low Water
MLLW	Mean Lower Low Water
m	Meter
mm	Millimeter
NMFS	National Marine Fisheries Service
NWA DPS	Northwest Atlantic Distinct Population Segment
RPMs	Reasonable and Prudent Measures -
SEFSC	Southeast Fisheries Science Center
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SPGP	State Programmatic General Permit
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

Background

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of critical habitat of such species; Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action “may affect” listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion (“Opinion”) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further conserve the species. In the case of Johnson’s seagrass, because take of listed marine plants is not prohibited and thus not included in an incidental take statement, the Opinion will not include RPMs, but instead limit itself to conservation recommendations.

This document represents NMFS’s Opinion based on its review of impacts associated with the USACE’s proposed action to issue a permit to RBYC, LLC for the modification of 2 existing docking facilities owned by Rybovich in Riviera Beach and West Palm Beach, and to issue a permit to FIND for the deepening of the ICW located west of Peanut Island and adjacent to the access channel for the Riviera Beach facility. The Riviera Beach project involves the modification of an existing 57-slip docking facility by dredging an access channel and constructing a mega-yacht (typically defined as yachts over 179 ft in length) facility that utilizes an advanced ship-lifting system. The existing dock configuration supports vessels up to 125 feet (ft) in length. The West Palm Beach facility currently has 59 slips and can moor vessels up to 285 ft in length, but does not have the capability to lift large vessels out of the water for repair, nor does it have the available space to install a large ship-lifting system. The project design involves slip reconfiguration, dredging, and expansion of the 2 existing marinas. In order to accommodate the large deep-draft vessels, FIND is proposing to deepen the ICW from its existing -10 ft depth to -15 ft mean low water (MLW) with a -2 ft over dredge. NMFS believes that the proposed deepening of the ICW would not occur at this time if it were not for the proposed changes to Rybovich’s Riviera Beach facility, as Rybovich is proposing to dredge an access channel from the ICW to the marina to accommodate the large vessels that will be towed up from their West Palm Beach facility for repairs. Therefore, we have determined that the projects are interrelated and interdependent and will be addressed together in this Opinion so that we can analyze the effects of the actions together. The Opinion analyzes the project’s effects on sea turtles, smalltooth sawfish, and Johnson’s seagrass, in accordance with Section 7 of the ESA, and is based on information provided by USACE and other sources of information including the published literature cited herein.

BIOLOGICAL OPINION

1 CONSULTATION HISTORY

October 14, 2011: NMFS receives a request for ESA consultation from the USACE for a construction permit application filed by RBYC, LLC to modify their Riviera Beach marina and to dredge a deeper access channel. The USACE determined that the project may affect sea turtles, smalltooth sawfish, and Johnson's seagrass and requested formal consultation. The project would remove approximately 180,000 cubic yards (yd³) of material over 8.69 acres. The seagrass survey performed on August 11, 2011, by Coastal Eco Group Incorporated indicated several acres of Johnson's seagrass are located within the project site

December 5, 2011: NMFS conducts a site visit and meeting with the applicant and consultant. According to the applicant, alternative site locations were investigated, but were either proven to not be feasible to accomplish the project purpose, or would result in additional impacts to seagrass habitat.

January 18, 2012: NMFS determines additional information regarding the project design is necessary to complete the consultation and submits a request for additional information to the USACE.

March 16, 2012: NMFS receives notification that the USACE has issued a permit application deactivation letter to the applicant.

May 17, 2012: NMFS receives notification that the applicant is requesting to submit a revised permit application.

June 25, 2012: The USACE issues a revised permit application for RBYC, LLC. It contains a modified access channel location that was necessary due to safe navigation concerns, but resulted in larger impacts to seagrass habitat. It includes 7.87 acres of proposed impacts to Johnson's seagrass habitat. NMFS Protected Resources Division provides initial comments about the increase in impacts to Johnson's seagrass.

February 13, 2013: NMFS receives notification that RBYC, LLC is planning to modify the project design due to NMFS's concerns about seagrass impacts.

March 27, 2013: USACE issues a permit application for the FIND ICW deepening project located west of Peanut Island in the Lake Worth Lagoon, Riviera Beach. NMFS notes that this project appears to be associated with the RBYC, LLC's request to modify their Riviera Beach facility.

August 21, 2013: RBYC, LLC provides updated information on the project design that includes a reduction in channel width and in proposed dredging depths.

February 12, 2014: NMFS PRD contacts the USACE for an update on the status of RBYC, LLC project permit application.

February 19, 2014: The USACE provides new information and updates to NMFS via email on the status of the project and includes information about both facilities owned by Rybovich in Palm Beach County and on the FIND deepening project.

February 21, 2014: NMFS receives a request from Representative Lois Frankel on the status of our review of the project. NMFS provides information to Rep. Frankel.

March 3, 2014: A third revised permit application is issued by the USACE for the RBYC, LLC. The permit application includes proposed modifications at the Riviera Beach facility and the West Palm Beach facility.

March 17, 2014: The USACE hosts an interagency meeting to discuss the 2 Rybovich facility modifications and the FIND deepening proposal for the ICW.

March 17, 2014: NMFS initiates formal consultation.

March 24, 2014: NMFS provides a letter informing the USACE that we will be reviewing both the Rybovich projects and the FIND project in a single Biological Opinion because NMFS believes that the projects are interrelated and interdependent.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

The proposed project involves the reconfiguration, expansion, dredging, and dock construction of 2 marinas owned by Rybovich. Both existing docking facilities to be modified are located in Riviera Beach and in West Palm Beach (Figure 1).

The purpose of the modifications is to provide services and repairs to mega-yachts. The applicant is seeking authorization to modify the 2 marinas to work in conjunction with each other to provide services and repairs to mega-yachts. The applicant has proposed that vessels would first go to the West Palm Beach facility where they would be prepared for hauling out of the water. Once they were ready, vessels would be towed approximately 3 miles north to the Riviera Beach facility for haul-out. Once repair work has been completed, the vessel would return to the West Palm Beach facility for dockage until departure. In order to safely navigate these yachts between the 2 marinas, the ICW would require deepening to -15 ft MLW from the Lake Worth Inlet to west of the Peanut Island Dredged Material Management Area (DMMA). FIND has submitted a separate permit application for the ICW deepening. Because NMFS believes all of these projects are interrelated and interdependent, we are including them together for analysis within this Opinion.

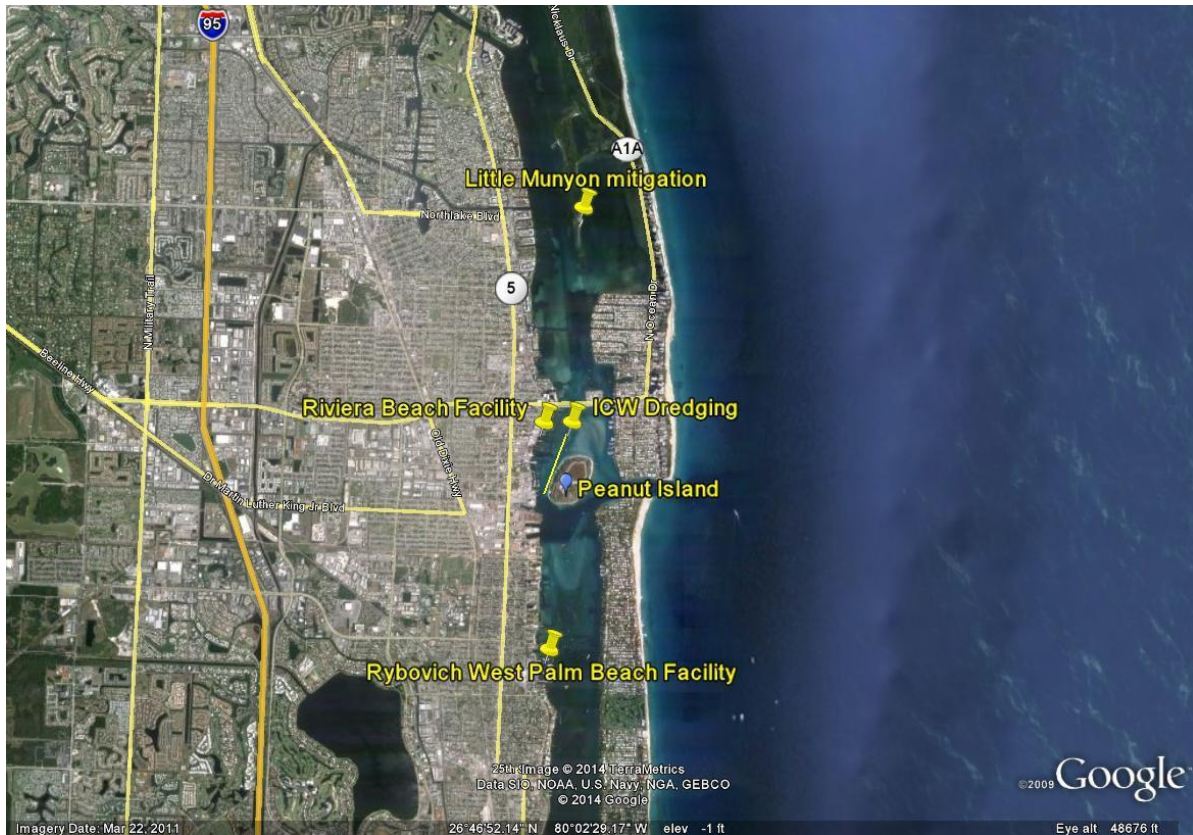


Figure 1. Image showing the location of the Riviera Beach Facility, West Palm Beach Facility, and the proposed ICW dredging

Riviera Beach Facility

Currently, the Riviera Beach facility has 57 wet slips and can accommodate vessels up to 125 ft in length. The proposed work would include dredging approximately 97,518 yd³ of material over 7.2 acres and would impact 3.99 acres of seagrass habitat. Approximately 1.93 acres of the seagrass habitat in the Riviera Beach project area consists of mixed beds of Johnson's seagrass (*Halophila johnsonii*), paddle grass (*Halophila decipiens*), and shoal grass (*Halodule wrightii*). The proposed construction activities at the Riviera Beach facility include:

1. Removal of the existing floating dock and construction of a new 13,610-square-foot (ft²) floating dock structure to accommodate either 3 vessels up to 330 ft in length or 10 vessels up to 100 ft in length.
2. The marina basin (605 linear feet [lin ft] long by 217 lin ft wide) will be dredged to depths ranging from -14 ft mean lower low water (MLLW) to -17 ft MLLW and a 125-ft-wide by 842-ft-long access channel to the ICW will be dredged to -14 ft MLLW. An irregular-shaped turning basin (257-ft-wide by 217-ft-long) adjacent to the ICW will be dredged to -14 ft MLLW.
3. The applicant will install a vessel lift system capable of removing 300-ft-long mega-yachts from the water. This will require removal of 45,000 yd³ of material adjacent to the upland property to a depth of -40 ft to -45 ft MLW.
4. The existing 653-lin-ft seawall will be repaired and replaced with 590-lin-ft of shoreline resulting in 84 yd³ of backfill.

5. An 842-lin-ft submerged sheet pile wall will be installed along the northern edge of the access channel. A 330-lin-ft submerged sheet pile wall will be installed along the northern edge of the vessel lift. In addition, a 95-lin-ft wall will be installed along the eastern perimeter, and a 330-lin-ft wall will be installed along the southern perimeter of the vessel lift. A 605-lin-ft wall will be installed along the southern perimeter of the proposed dock. A 128-lin-ft seawall will be installed along the southern dredge transition area. A 471-lin-ft sheet pile wall will be installed along the southern edge of the access channel. The submerged walls are to have a top elevation of -3.88 ft MLLW around the perimeter of the marina basin and would have a top elevation of -4.88 ft MLLW adjacent to the access channel.

West Palm Beach Facility

Currently, the West Palm Beach facility has 59 wet slips and can moor vessels up to 285 ft in length. To complete the work at this facility, 23.24 acres would be dredged to -17 ft MLLW and 2.46 acres would be dredged to -15 ft MLLW. The total dredging volume would be approximately 155,640 yd³ of material removed that would impact a total of 0.46 acre of seagrass habitat. Johnson's seagrass is found throughout the 0.46 acre area of seagrass habitat. The proposed construction activities at the West Palm Beach facility include:

1. Removal of existing docks and the construction of 51,213 ft² of new docks and 410 ft² of ramps and landings over water.
2. The facility would be expanded to the north approximately 3.95 acres, which would be dredged to -17 ft MLLW and would be expanded to the east by approximately 2.46 acres, which would be dredged to -15 ft MLLW.
3. Dredging of the existing marina (19.29 acres) to -17 ft MLLW.

Dredged material spoil is proposed for disposal in the Peanut Island DMMA. Bottom sediments include sand, silty sand, and shell hash, and the shallow shoal bottom adjacent to the access channel and ICW is characterized by small rubble and shell. Seagrasses within the project footprint will be removed by dredging, and dredging impacts will be mitigated. Propeller-scarring impacts to seagrasses are not expected as water depths within the project area are sufficiently deep to allow access for construction equipment. All construction related equipment will be restricted to identified construction/dredge areas and within dredged channels. Dredging will be conducted with the use of a mechanical (clamshell type) or hydraulic (suction type) dredge.

Turbidity testing will be implemented in accordance with state and federal permits to ensure compliance with State of Florida water quality standards. Temporary increases in turbidity are expected during project construction. Floating turbidity curtains will be used around the project area to contain dredging-related turbidity to within the immediate construction area.

The applicant would be required to adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*. Due to the commercial nature of the proposed project, the construction of the dock will not conform to the August 2001 *Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat* or the *Key for Construction Conditions for Docks or Other Minor*

Structures Constructed in or over Johnson’s Seagrass. Construction is expected to take approximately 2.5 years.

Mitigation Actions

During the 3 revisions of the proposed project, the applicant has reduced the access channel width at the Riviera Beach facility from a width of 275 ft to a width of 125 ft. The dredge depths have also been reduced from -14.88 ft MLLW to -14.0 ft MLLW in the proposed access channel. These modifications reduced seagrass impacts from 7.88 acres to 3.99 acres. With a 0.46 acre of proposed impacts at the West Palm Beach facility, the combined total of impacts to seagrass habitat for both facilities would be 4.45 acres. Approximately 2.39 acres of the total impacts would include Johnson’s seagrass (1.93 acres at the Riviera Beach facility and 0.46 acre at the West Palm Beach facility).

Rybovich is proposing to offset impacts to seagrass habitat through seagrass mitigation performed at the Old Port Cove Dredge Hole that is located just north of the project area. The mitigation consisted of filling the dredge hole to appropriate levels to create seagrass habitat. NMFS is confident that the work resulted in an ecological lift and analysis shows a sufficient amount of the dredged hole has been filled to accomplish seagrass mitigation that would offset impacts at the Rybovich facilities. .

As part of the proposed project to expand/reconfigure the 2 marina facilities, the applicant will pursue the “Clean Marina” designation from the Florida Department of Environmental Protection (FDEP), which acknowledges the implementation of environmentally sensitive procedures and training. Additionally, the existing storm water treatment for the upland portions of the Riviera Beach facility will be modified to improve water quality in the immediate vicinity of the project area.

FIND ICW Deepening

The purpose of this project is to deepen a portion of the ICW that is located in Riviera Beach from the current -10 ft MLW to -15 ft MLW with a -2 ft over-dredge. Dredging of the ICW would be conducted from the Lake Worth Inlet to southwest of Peanut Island for a length of 3,555 lin ft. Channel slopes would be dredged within the 100-ft-wide channel with 3H:1V side slopes. A mechanical (clamshell type) or hydraulic (suction type or cutterhead suction type) dredge would be used. Approximately 95,580 yd³ of material would be removed and placed within the Peanut Island DMMA. The dredging would impact 0.15 acre of hardbottom and 5.82 acres of seagrass habitat, including 0.21 acre of Johnson’s seagrass.

The proposed mitigation for impacts to hardbottom would be offset through the creation of a reef at Sugar Sands Artificial Reef Area. Seagrass impacts would be mitigated by using mitigation credits at the Snook Island Natural Area or by performing additional mitigation actions at the Old Port Cove Dredge Hole.

2.2 Action Area

50 CFR 404.02 defines action area as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.” The action area for these

projects includes the waters and submerged lands within and in the immediate vicinity of the project sites within the Lake Worth Lagoon, Palm Beach County, Florida. The Riviera Beach facility is located adjacent to 2010 Avenue B, at 26.7789°N latitude, 80.0510°W longitude in Riviera Beach and the West Palm Beach facility is located adjacent to 4200 North Flagler Drive in West Palm Beach at 26.7493°N latitude, 80.0506°W longitude. The FIND ICW deepening project midpoint is located at 26.7750°N latitude, 80.0480°W longitude (North American Datum 1983). The action area also includes the proposed mitigation area at Old Port Cove Dredge Hole, which is located within Lake Worth Lagoon north of the Riviera Beach facility.

3 STATUS OF LISTED SPECIES

The following endangered (E) and threatened (T) species under the jurisdiction of NMFS may occur in or near the action area:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Sea Turtles		
Loggerhead sea turtle	<i>Caretta caretta</i> ¹	T
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	E
Leatherback sea turtle	<i>Dermochelys coriacea</i>	E
Kemp’s ridley sea turtle	<i>Lepidochelys kempii</i>	E
Green sea turtle	<i>Chelonia mydas</i> ²	E/T
Fish		
Smalltooth sawfish	<i>Pristis pectinata</i>	E
Plants		
Johnson’s seagrass	<i>Halophila johnsonii</i>	T

Critical Habitat

ESA designated critical habitat for NMFS-listed species does not occur within the action area.

3.1 Species Not Likely to be Adversely Affected

Sea Turtles and Smalltooth Sawfish

Five species of sea turtles (loggerhead, hawksbill, leatherback, Kemp’s ridley, and green) and smalltooth sawfish may be found in or near the action area. The project may affect sea turtles and smalltooth sawfish by injury or death from interactions with equipment or materials used during construction or placement of piles. During construction, the greatest likelihood for encounters with sea turtles would be with support boats moving from dock areas to dredge vessels. Temporary short-term noise impacts would occur during daylight hours during the

¹ Northwest Atlantic Ocean (NWA) Distinct Population Segment. On September 16, 2011, NMFS and USFWS issued a final rule changing the listing of loggerhead sea turtles from a single, threatened species to nine distinct population segments (DPSs) listed as either threatened or endangered. The NWA DPS was listed as threatened.

² Green turtles are listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are listed as endangered.

construction period. No long-term noise impacts are expected. The risk is discountable as these species are highly mobile and can easily avoid these interactions. Also, the applicant will be required to implement NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, which will further reduce the chance of an interaction. Sea turtles and smalltooth sawfish may be affected by being temporarily unable to use the site due to potential avoidance of construction activities and related noise, and physical exclusion from areas contained by turbidity curtains, but these effects will be insignificant. Disturbance from construction activities and related noise will be intermittent and only occur during the day for part of the construction period; turbidity curtains will only enclose small areas at any one time in the project area, will be removed upon project completion, and will not appreciably interfere with use of the area by listed species. These effects will be insignificant due to the project's footprint in relation to similar adjacent habitat.

Any sea turtles or smalltooth sawfish potentially found in proximity to the project area will likely only be passing through, en route to foraging areas and only opportunistically feeding. Smalltooth sawfish have been sighted within 5 miles of the action area, but all observations were off the coast in the Atlantic Ocean, in waters 30 ft or deeper. The loss of seagrass habitat would be insignificant to smalltooth sawfish and sea turtles because of the small ratio of habitat lost in comparison to similar adjacent habitat that would not be disturbed.

The proposed use of the project areas is for temporary mooring of large vessels; therefore, the immediate area will be designated as a slow/no-wake area, vessels will be towed from the West Palm Beach facility to the Riviera Beach facility, and vessels moving under their own power will go at a minimum speed. According to the applicant, the larger vessels using the facility will not be traveling under their own power, but will be guided to/from the dock by smaller towing vessels. Finally, the reconfiguration of the existing facility will result in fewer available slips, therefore causing a reduction in the number of boats that can use the facility at any given time. Fewer vessels and slower speeds would result in less risk of collision with listed species than currently exist at the facility. For these reasons, the effects of the proposed action on sea turtles will be discountable.

3.2 Species Likely to be Adversely Affected

NMFS believes Johnson's seagrass (*Halophila johnsonii*) is likely to be adversely affected by the proposed action. Johnson's seagrass is the first marine plant ever listed under the ESA. Its listing as threatened under the ESA on September 14, 1998, was based on the results of fieldwork and a status review initiated in 1990. Kenworthy (1993, 1997, 1999) and NMFS (2007) discuss the results of the field studies and summarize an extensive literature review regarding the status of Johnson's seagrass. The following discussion summarizes those findings relevant to our evaluation of the proposed action.



Johnson's seagrass

Life History and Population Biology

Based on the current knowledge of the species, Johnson's seagrass reproduction is believed to be entirely asexual, and dispersal is by vegetative fragmentation. Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys have not discovered male flowers, fertilized ovaries, fruits, or seeds either in the field or under laboratory conditions (Jewett-Smith et al. 1997; Hammerstrom and Kenworthy 2002; NMFS 2007). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting either that the species does not reproduce sexually or that the male flowers are difficult to observe or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean.

Throughout its range, Johnson's seagrass occurs in dynamic and disjunctive patches. It spreads rapidly, growing horizontally from dense apical meristems with leaf pairs having short life spans (Kenworthy 1997). Kenworthy suggested that the observed horizontal spreading, rapid growth patterns, and high biomass turnover could explain the dynamic patches observed in distribution studies of this species. While patches may colonize quickly, they may also disappear rapidly. Sometimes they will disappear for several years and then reestablish: a process referred to as "pulsating patches" (Heidelbaugh et al. 2000; Virnstein and Morris 2007; Virnstein et al. 2009). Mortality, or the disappearance of patches, can be caused by a number of processes, including burial from bioturbation and sediment deposition, erosion, herbivory, desiccation, and turbidity. In the absence of sexual reproduction, one possible explanation for the pulsating patches is dispersal and reestablishment of vegetative fragments, a process that commonly occurs in aquatic plants and has been demonstrated in other seagrasses (Philbrick and Les 1996, DiCarlo et al. 2005), and was recently confirmed by experimental mesocosm studies with Johnson's seagrass (Hall et al. 2006).

Johnson's seagrass is a shallow-rooted species that is vulnerable to uprooting by wind, waves, storm events, tidal currents, bioturbation, and motor vessels. It is also vulnerable to burial by sand movement and siltation (Heidelbaugh et al. 2000). Having a canopy of only 2-5 centimeters (cm), it may be easily covered by sediments transported during storms or redistributed by macrofaunal bioturbation during the feeding activities of benthic organisms. Mesocosm experiments indicate that clonal fragments can only survive burial for up to a period of 12 days (W.J. Kenworthy, CCFHR, NOAA, Beaufort, North Carolina, unpublished). Mechanisms capable of disturbing patches may create clonal fragments that become dispersed. Hall, (et al 2006) showed that drifting fragments of Johnson's seagrass can remain viable for 4 to 8 days, during which time they can settle, root, and grow. Fragments could drift several kilometers under the influence of wind and tidally- driven circulation, providing potential recruits for dispersal and new patch formation. In the absence of sexual reproduction, these are likely to be the most common forms of dispersal and patch maintenance.

Status and Distribution

Johnson's seagrass occurs in a variety of habitat types, including on intertidal wave-washed sandy shoals, on flood deltas near inlets, in deep water, in soft mud, and near the mouths of canals and rivers, where presumably water quality is sometimes poor and where salinity fluctuates widely. It is an opportunistic plant that occurs in a patchy, disjunctive distribution from the intertidal zone to depths of approximately 2-3 meters in a wide range of sediment types, salinities, and in variable water quality conditions (NMFS 2007).

Johnson's seagrass exhibits a narrow range of distribution and has only been found growing along approximately 200 kilometers (km) of coastline in southeastern Florida north of Sebastian Inlet, Indian River County, south to Virginia Key in northern Biscayne Bay, Miami-Dade County. This apparent endemism suggests that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world. Kenworthy (1997 and 1999) confirmed its limited geographic distribution in patchy and vertically disjunctive areas throughout its range. Since the last status review (NMFS 2007), there have not been any reported reductions in the geographic range of the species. In fact, the St. Johns River Water Management District (SJRWMD) observed Johnson's seagrass approximately 21 km north of the Sebastian Inlet mouth on the western shore of the Indian River Lagoon– a discovery that slightly extends the species' known northern range (Virnstein and Hall 2009).

Two survey programs regularly monitor the presence and abundance of Johnson's seagrass within this range. One program, conducted by the SJRWMD since 1994, covers the northern section of the species' geographic range between Sebastian Inlet and Jupiter Inlet (Virnstein and Morris 2007; Virnstein et al. 2009). The second survey, initiated in 2006, is of the southern range of the species between Jupiter Inlet and Virginia Key in Biscayne Bay (Kunzelman 2007). Johnson's seagrass has been found to be a perennial species showing no consistent seasonal or year-to-year pattern in these surveys, but has exhibited some winter decline. However, during exceptionally mild winters, Johnson's seagrass can maintain or even increase in abundance from summer to winter. In the surveys conducted between 1994 and 2007, it occurred in 7.1% of the 1-square-meter quadrats in the northern range. Depth of occurrence within these surveys ranged from 0.03-2.5 meters (m).

Based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of the species from Jupiter Inlet to Virginia Key, at least during periods of relatively good environmental conditions and no significant large-scale disturbances (NMFS 2007). The largest reported contiguous meadow of Johnson's seagrass in the southern range was observed in Lake Worth Lagoon and was estimated to be 30 acres (Kenworthy 1997). Eiseman and McMillan (1980) documented Johnson's seagrass in the vicinity of Virginia Key (Latitude 25.75°N); this location is considered to be the southern limit of the species' range. There have been no reports of this species further south of the currently known southern distribution. The presence of Johnson's seagrass in northern Biscayne Bay (north of Virginia Key) is well documented. In addition to localized surveys, the presence of Johnson's seagrass has been documented by various field experiences and observations of the area by federal, state, and county entities. Johnson's seagrass has been documented in various USACE and U.S. Coast Guard (USCG) permit applications reviewed by NMFS.

Information on the species' distribution and results of limited experimental work suggest that Johnson's seagrass has a wider tolerance range for salinity, temperature, and optical water quality conditions than other species, such as paddle grass (*Halophila decipiens*) (Dawes et al. 1989; Kenworthy and Haunert 1991; Gallegos and Kenworthy 1996; Kenworthy and Fonseca 1996; Durako et al. 2003; Kunzelman et al. 2005; Torquemada et al. 2005). Johnson's seagrass has been observed growing perennially near the mouths of freshwater discharge canals (Gallegos and Kenworthy 1996), in deeper turbid waters of the interior portion of the Indian River Lagoon (Kenworthy 2000; Virnstein and Morris 2007), and in clear water associated with the high energy environments and flood deltas inside ocean inlets (Kenworthy 1993, Kenworthy 1997; Virnstein et al. 1997; Heidelbaugh et al. 2000; Virnstein and Morris 2007). It can colonize and persist in high tidal-energy environments and has been observed where tidal velocities approach the threshold of motion for unconsolidated sediments ($35\text{-}40\text{ cm s}^{-1}$). The persistent presence of high-density, elevated patches of Johnson's seagrass on flood tidal deltas near inlets suggests that it is capable of sediment stabilization. Intertidal populations of Johnson's seagrass may be completely exposed at low tides, suggesting high tolerance to desiccation and wide temperature tolerance. In Virnstein's study areas within the Indian River Lagoon, Johnson's seagrass was found associated with other seagrass species or growing alone in the intertidal, and, more commonly, at the deep edge of some transects. In areas in which long-term, poor water and sediment quality have existed until recently, Johnson's seagrass appears to occur in relatively higher abundance perhaps due to the inability of the larger species to thrive. Johnson's seagrass appears to be out-competed in seagrass habitats where environmental conditions permit the larger seagrass species to thrive (Virnstein et al. 1997; Kenworthy 1997). However, where the larger, canopy-forming species are absent, Johnson's seagrass can grow throughout the full seagrass depth range (NMFS 2007).

Observations by researchers have suggested that Johnson's seagrass exploits unstable environments or newly-created, unvegetated patches by exhibiting fast-growth and support for all local ramets (a ramet is an individual plant that has grown vegetatively from another individual as a clone of that plant) in order to exploit areas in which it could not otherwise compete. It may quickly recruit to locally uninhabited patches and through prolific lateral branching and fast horizontal growth, but may decline once conditions become unfavorable.

While these attributes may allow it to compete effectively in periodically disturbed areas, if the distribution of this species becomes limited to stable areas it may eventually be out-competed by more stable-selected plants represented by the larger-bodied seagrasses (Durako et al. 2003). In addition, the physiological attributes of Johnson's seagrass may limit growth (i.e., spreading) over large areas of substrate if the substrate is somehow altered (e.g., dredging to a depth that would preclude future recruitment of Johnson's seagrass); therefore, its ability to recover from widespread habitat loss may be limited. The clonal and reproductive growth characteristics of Johnson's seagrass result in its distribution being patchy, non-contiguous, and temporally fluctuating. These attributes suggest that colonization between broadly disjunctive areas is likely difficult and that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means.

Threats

The most clearly identified threat to date is the possibility of mortality due to reduced salinity over long periods of time. Some studies have shown that Johnson's seagrass has a wide tolerance for salinity; however, short-term experiments have shown reduced photosynthesis and increased mortality at low salinities (< 10 practical salinity units [psu]). Longer duration mesocosm experiments have resulted in 100% mortality of Johnson's seagrass after 10 days at salinities less than 10 psu (Kahn and Durako 2008). The Johnson's Seagrass Recovery Implementation Team has determined that the most significant threat to the species is the present or threatened destruction, modification or curtailment of its habitat or range through water management practices and stochastic environmental factors that can alter the salinity of Johnson's seagrass habitat. Given that it is not uncommon for salinities to decline below 15-20 psu in its range (Steward et al. 2006), and that a number of natural and human-related factors can affect salinity throughout its range, the team identified reduced salinity as a potential significant threat to the species. In the critical habitat designation rule and in the Recovery Plan, several additional threats were also considered: (1) dredging and filling, (2) construction and shading from in- and over-water structures, (3) propeller scarring and anchor mooring, (4) trampling, (5) storms, and (6) siltation. Since the listing, the Team has conducted assessments of each of these factors and has been unable to confirm that any of these pose a significant threat to the existence of the species. A brief summary discussion of these factors follows.

Dredging and filling activities and the construction of in- and over-water structures are closely scrutinized through federal, state, and local permitting programs. The USACE, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, has federal authority over the issuance of dredge and fill permits. This permitting process includes language to protect and conserve seagrasses through field evaluations, consultations, and recommendations to avoid, minimize and mitigate for impacts to seagrasses. The USACE's State (Florida) Programmatic General Permit Program (SPGP) authorizes permits for the construction of docks, boat ramps, piers, maintenance dredging, and the construction of other minor over-water structures. The SPGP has had an increase in the number of permits authorized between 2000 and 2006 (based on data provided by the USACE), except for periods when the USFWS was involved in litigation over the manatee (*Trichechus manatus latirostris*). Additional levels of consultation by NMFS staff may directly address permits involving Johnson's seagrass, depending on the location and size of the project and if the proposed project is in critical habitat. The Team has worked with NMFS's Protected Resources and Habitat Conservation staff to develop and improve guidelines

for site monitoring methods (Greening and Holland 2003), dock construction guidelines (NMFS and USACE 2002; Shafer et al. 2008), and best management practices to minimize the impact of docks on Johnson's seagrass (Landry et al. 2008).

Dock height, width, and orientation have been identified as the 3 most important factors affecting seagrass growth (Burdick and Short 1999). In their report on the effects of docks on seagrasses, Landry (et al. 2008) stated there is a compelling argument supporting prior studies that indicate that docks can have negative impacts on seagrasses by reducing their abundance and in some cases, preventing seagrass from growing. They found that although it is reduced in frequency under docks with grated decking, Johnson's seagrass was observed in higher densities under the grated docks compared to non-grated docks. Furthermore, their results suggest that Johnson's seagrass does benefit from the light-transmitting characteristics of grated decking. Landry (et al. 2008) found that transects under grated docks were not significantly different from the adjacent and the reference transects for Johnson's seagrass. This suggests that while both grated and non-grated docks may affect seagrass beds, grated decking does not appear to cause significant harm to Johnson's seagrass and it is less detrimental to other seagrass species (W.J. Kenworthy, (retired) National Ocean Service, pers. comm. to K. Davy, NMFS, 2013). Given the supporting experimental evidence that fiberglass grating does improve the incident solar radiation penetrating under structures (Shafer and Robinson 2001), continuing to require grated decking will benefit most seagrasses. Landry (et al. 2008) recommend that grated decking should be used for any dock construction to take place over seagrasses, most importantly Johnson's seagrass.

In the results from their study evaluating the regulatory construction guidelines to minimize impacts to seagrasses from single-family residential dock structures in Florida and Puerto Rico, Shafer (et al. 2008) emphasized avoidance of seagrasses as a first priority. Avoidance may be achieved by relocating or realigning the structure. It is important to note that Shafer (et al. 2008) observed that in the majority of cases, permit applicants and regulatory agencies are, when practical, generally succeeding in avoiding seagrass impacts by extending the length of the access walkway so that the terminal platform is constructed in deep water that is not conducive to seagrass growth. If avoidance is not possible, Shafer (et al. 2008) recommend revising the USACE-NMFS dock construction guidelines to prioritize dock orientation (in a north-south direction) and height (minimum of 5 ft above mean high water) as the most important specifications for the survivorship of seagrasses under docks.

While most dock construction is subject to the construction guidelines (i.e., the USACE and NMFS jointly developed October 2002, *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or over Johnson's Seagrass* and the associated August 2001, *Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh, or Mangrove Habitat*), some docks meeting certain provisions, are exempt from state permitting (<http://www.dep.state.fl.us/central/Home/SLERP/Docks/sfdock.pdf>) and contribute to the loss of Johnson's seagrass through construction impacts and shading.

The USACE's SPGP authorizes permits for the construction of docks, boat ramps, piers, maintenance dredging, and the construction of other minor over-water structures. NMFS

completed programmatic ESA Section 7 consultation with the USACE in December 2011 on the current 5-year SPGP. The Opinion includes conservation recommendations for Johnson's seagrass. In addition to shading from docks, fixed add-ons to exempt docks (such as finger piers, floating docks, or boatlifts) have been documented as an additional source of seagrass loss due to shading (Smith and Mezich 1999).

Routine maintenance dredging associated with the constant movement of sediments in and around inlets may affect seagrasses by direct removal, light limitation due to turbidity, and burial from sedimentation. The disturbance of sediments can also destabilize the benthic community. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plants, fragmentation of habitat, shading, turbidity, and sedimentation.

During their review, the Team identified weaknesses in the oversight practices of state and federal agencies in the permitting process due to budget, staffing, and technological limitations. The Team also identified difficulties in monitoring a rare and patchily-distributed species in single-event surveys associated with permit applications and continues to work with collaborators to improve monitoring methods. While it is recognized that the activities described above may adversely affect Johnson's seagrass and its habitat, the Team determined that these activities were local and small-scale and the deficiencies in the permitting process were not presently a significant threat to the survival of Johnson's seagrass because they will not individually or cumulatively result in long-term, large-scale mortality of Johnson's seagrass, and preclude the species from its strategy of recolonizing areas.

Both propeller scarring and improper anchoring are known to adversely affect seagrasses (Sargent et al. 1995; Kenworthy et al. 2002). These activities can severely disrupt the benthic habitat by uprooting plants, severing rhizomes, destabilizing sediments, and significantly reducing the viability of the seagrass community. Propeller dredging and improper anchoring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity within Florida. The most complete records available indicate that in 2012, there were 891,981 registered vessels³ in Florida (www.flhsmv.gov/dmv/TaxCollDocs/vesselstats2012). This number is likely to increase based on Florida's projected population growth of up to 25 million in 2025 (www.propertytaxreform.state.fl/docs/eo06141.pdf). An increase in the number of registered vessels will likely lead to an increase in adverse effects to seagrasses caused by propeller dredging/scarring. Other indirect effects associated with motor vessels include turbidity from operating in shallow water, dock construction and maintenance, marina expansion, and inlet maintenance dredging. These activities are also likely to increase (NMFS 2007). Damage to seagrasses from propeller scarring and improper anchoring by motor vessels is recognized as a significant resource management problem in Florida (Sargent et al. 1995). A wide range of local, state, and federal statutes protect seagrasses from damage due to vessel impacts and a number of conservation measures, including the designation of vessel control zones, signage and public awareness campaigns, are directed at minimizing vessel damage to seagrasses. Despite

³ Excluding canoes. Florida vessel registration requirements apply to all powered vessels regardless of size and all non-powered vessels greater than 16 feet in length.

these efforts, vessel damage can have significant local and small-scale (one square meter to 100 square meters) impacts on seagrasses (Kirsch et al. 2005), but there is no direct evidence that these small-scale local effects are so widespread that they are a threat to the survival of Johnson's seagrass.

Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat but is a lesser concern. Trampling damages seagrasses by pushing leaves into the sediment and crushing or breaking the leaves and rhizomes. However, since the designation of critical habitat there have been no documented observations or reports of damage by trampling and if there was, it would be small-scale and local. Therefore, the Team determined that trampling does not constitute a significant threat to the survival of the Johnson's seagrass.

Large-scale weather events, such as tropical storms and hurricanes, while they often generate runoff conditions that decrease water quality; they also produce conditions (wind setup and abrupt water elevation changes) that can increase flushing rates. The effects of storms can be complex. Specifically documented storm effects on seagrasses include the following: (1) scouring and erosion of sediments, (2) erosion of seeds and plants by waves, currents, and surge, (3) burial by shifting sand, (4) turbidity, and (5) discharge of freshwater, including inorganic and organic constituents in the effluents (Steward et al. 2006). Storm effects may be chronic, e.g., due to seasonal weather cycles, or acute, such as the effects of strong thunderstorms or tropical cyclones. Studies have demonstrated that healthy, intact seagrass meadows are generally resistant to physical degradation from severe storms, whereas damaged seagrass beds may not be as resilient (Fonseca et al. 2000; Whitfield et al. 2002). In the late summer and early fall of 2004, 4 hurricanes passed directly over the northern range of Johnson's seagrass in the Indian River Lagoon. A post-hurricane random survey in the area of the Indian River Lagoon affected by the 4 hurricanes indicated the presence of Johnson's seagrass was similar to that reported by the SJRWMD transect surveys prior to the storms. This indicates that while the species may decline initially, under the right conditions it can return quickly (Virnstein and Morris 2007). Despite evidence of longer-term reductions in salinity, increased water turbidity, and increased water color associated with higher than average precipitation in the spring of 2005, there was no evidence of long-term chronic impacts to seagrasses and no direct evidence of damage to Johnson's seagrass that could be considered a threat to the survival of the species (Steward et al. 2006).

Silt derived from adjacent land and shoreline erosion, river and canal discharges, inlets, and internally re-suspended materials can lead to the accumulation of material on plant leaves causing light deprivation. Deposition of silt can also lead to the burial of plants, accumulation of organic matter, and anoxic sediments. Johnson's seagrass grows in a wide range of environments, including those that are exposed to siltation from all the potential sources. Documentation of the direct effects of siltation on seagrasses is generally unavailable. The absence of seagrass has been associated with the formation of muck deposits, however, and localized areas of flocculent, anoxic sediments in isolated basins and segments of the Indian River Lagoon have been observed. Furthermore, sustained siltation experimentally simulated by complete burial for at least 12 days may cause mortality of Johnson's seagrass (W.J. Kenworthy, National Ocean Service, Beaufort, North Carolina, unpublished data). In general, the effects of

siltation are localized and not widespread and are not likely to threaten the survival of the species.

Availability of light is one of the most significant environmental factors affecting the survival, growth, and distribution of seagrasses (Bulthuis 1983; Dennison 1987; Abal et al. 1994; Kenworthy and Fonseca 1996). Water quality and the penetration of light are affected by turbidity (suspended solids), color, nutrients, and chlorophyll and are major factors controlling the distribution and abundance of seagrasses (Dennison et al. 1993; Kenworthy and Haurert 1991; Kenworthy and Fonseca 1996). Increases in color and turbidity values throughout the range of Johnson's seagrass are generally caused by high flows of freshwater discharged from water management canals, which can also reduce salinity. Wastewater and stormwater discharges, as well as from land runoff and subterranean sources, are also causes of increased turbidity. Degradation of water quality due to increased land use and poor water management practices continues to threaten the welfare of seagrass communities. Declines in water quality are likely to worsen unless water management and land use practices can curb or eliminate freshwater discharges and minimize inputs of sediments and nutrients. A nutrient-rich environment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural runoff stimulates increased algal growth that may smother or shade Johnson's seagrass, or shade-rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

Based on a Trophic State Index of ambient water quality obtained in the northern and central region of Johnson's seagrass geographic range provided in a long-term monitoring program implemented by the SJRWMD, overall estuarine water quality was assessed as mostly good (67%) (Winkler and Ceric 2006). Only 28% of the stations sampled had fair water quality, while 6% had poor quality. Also many more sites were improving than were degrading, 50% of the sampled estuarine sites were improving, while 6% were degrading, 42% of the lagoon sites had an insignificant trend, while 3% had insufficient data to determine a trend. As water management experts have now become confident in the correspondence between water quality and seagrass depth distribution, they have begun establishing water quality targets for the Indian River Lagoon by using seagrass as an indicator (Steward et al. 2005). There is a strong positive correlation between seagrass depth distribution and water quality, which enables managers to predict where seagrasses will grow based on water quality and the availability of light. Given that at least half of the stations were indicating long-term improvements in water quality, it can be assumed that seagrass abundance should not be negatively impacted if water and land use management programs continue to be effective. For example, carefully controlling or reducing water flows from discharge canals will moderate salinity fluctuations and reduce turbidity, color, and light attenuation values. Even so, there may be localized degradation near urbanized sites with multiple water quality problems that are more difficult to manage, such as the vicinity of the Saint Lucie Inlet where the discharges from Lake Okeechobee have had significant impacts on water quality and seagrasses.

There has not been a comprehensive assessment of water quality published or reported for the southern range of Johnson's seagrass similar to the SJRWMD study. However, water quality experts at the South Florida Water Management District (SFWMD) report that efforts are underway to synthesize water quality information and to gain a more comprehensive

understanding of the long-term status and trends of water quality in the southern range of Johnson's seagrass. Of particular concern is an assessment of the impacts of fluctuations in water quality corresponding with variation in climatology, especially "wet years" versus "dry years" variation. Future recovery efforts should include close coordination with the SFWMD and county environmental management agencies in Palm Beach and Dade counties to evaluate the status and trends of water quality in these regions of the species' distribution.

In addition to the 6 factors discussed above, we also consider the possible effects of climate change on Johnson's seagrass. Specifically, we consider the possible effects of rising temperatures and sea levels on Johnson's seagrass. While sea level has changed many times during the evolutionary history of this species and Johnson's seagrass seems to handle temperature changes fairly well (W.J. Kenworthy, National Ocean Service, pers. comm. to A. Livergood, NMFS, 2010), it is uncertain how this species will fare when considering the combined effects of rising temperatures and sea levels. Here, we consider some potential effects of rising temperatures and sea levels on seagrasses in general, including some discussion on potential effects on Johnson's seagrass in particular.

The earth is projected to warm between 2°-4°C by 2100, and similar projections have been made for marine systems (Sheppard and Rioja-Nieto 2005). At the margins of temperate and tropical bioregions and within tidally-restricted areas where seagrasses are growing at their physiological limits, increased temperatures may result in losses of seagrasses and/or shifts in species composition (Short et al. 2007). The response of seagrasses to increased water temperatures will depend on the thermal tolerance of the different species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1998).

With future climate change and potentially warmer temperatures, there may be a 1-5 m rise in the seawater levels by 2100 when taking into account the thermal expansion of ocean water and melting of ocean glaciers. Rising sea levels may adversely impact seagrass communities due to increases in water depths above present meadows, thus reducing available light. Changing currents may cause erosion and increased turbidity and seawater intrusions higher up on land or into estuaries and rivers, which could increase landward seagrass colonization (Short and Neckles 1998). A landward migration of seagrasses with rising sea levels is a potential benefit, so long as suitable substrate is available for colonization. Climate change may also reduce light by shifting weather patterns to cause increased cloudiness. It has been shown that evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation. Consider that sea levels have changed many times in the evolutionary history of Johnson's seagrass (W.J. Kenworthy, National Ocean Service, pers. comm. to A. Livergood, NMFS, 2010); it is possible that rising sea levels could potentially benefit Johnson's seagrass and other seagrass species (i.e., via landward migration) so long as suitable substrate is available for colonization.

It is uncertain how Johnson's seagrass will adapt to rising sea levels and temperatures; much of it depends on how much temperatures increase and how quickly. For example, Johnson's seagrass that grows intertidally (e.g., in some parts of the Lake Worth Lagoon) may be affected by a slight change in temperature (since it may already be surviving under less than optimal conditions); however, this may be ameliorated with rising sea levels, assuming Johnson's seagrass would

migrate landward with rising sea levels and assuming that suitable substrate would be available for a landward migration.

In summary, rising sea levels may potentially benefit Johnson's seagrass and other seagrass species, assuming they are able to migrate landward and assuming suitable substrate is available. However, rising sea levels could also adversely impact seagrass communities due to increases in water depths above present meadows reducing available light. Although reduction in light availability may benefit some seagrass species (e.g., *Halophila* species that require less light compared to the larger, canopy-forming species); therefore, much depends on the thermal tolerance of the different seagrass species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1998). It is uncertain how Johnson's seagrass and other seagrass species will be affected by the synergistic effects of rising temperatures and sea levels (in combination with other stressors, such as reduced salinity from freshwater runoff). It has been shown that evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

Status Summary

Based on the results of 14 years of monitoring in the species' northern range (1994-2007) and 3 years of monitoring in the species' southern range (2006-2009), there has been no significant change in the northern or southern range limits of Johnson's seagrass (NMFS 2007). It appears that the populations in the northern range are stable and capable of sustaining themselves despite stochastic events related to severe storms (Steward et al. 2006) and fluctuating climatology. Longer-term monitoring data is needed to confirm the stability of the southern distribution of the species (NMFS 2007). However, based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of Johnson's seagrass from Jupiter Inlet to Virginia Key, at least during periods of relatively good environmental conditions and no significant large-scale disturbances. Larger seagrasses, predominantly turtle grass (*Thalassia testudinum*), begin to out-compete Johnson's seagrass in this area. While there has been a slight extension in the known northern range (Virnstein and Hall 2009), the limits of the southern range appear to be stable (Latitude 25.75°N in the vicinity of Virginia Key). There have been no reports of this species further south of the currently known southern distribution.

As discussed in the *Threats* section, the Recovery Team has determined that the most clearly identified threat to the survival of the species is the possibility of mortality due to reduced salinity over long periods of time. The other potential threats discussed above (i.e., dredging/filling, construction and shading from in and over-water structures, propeller scarring and anchor mooring, trampling, storms, siltation, and climate change) were determined to be generally local and small-scale and are not considered threats to the survival and recovery of the species. It is uncertain how Johnson's seagrass and other seagrass species will fare due to the synergistic effects of rising temperatures and sea levels (in combination with other stressors, such as reduced salinity from freshwater runoff). It has been shown that evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

4 ENVIRONMENTAL BASELINE

This section is a description of the past and ongoing human and natural factors leading to the current status of the species within the action area. The environmental baseline is a “snapshot” of the action area at a specified point in time and includes state, tribal, local, and private actions already affecting the species that will occur contemporaneously with the consultation in progress. Unrelated federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are federal and other actions within the action area that may benefit the listed species. The purpose of describing the environmental baseline in this manner is to provide context for the effects of the proposed action on the listed species. In sum, we evaluate the relevant baseline to determine whether there are effects on the listed species in the baseline that may act synergistically with the effects of the proposed action. For example, some individuals of listed species may be exposed to stressors of other activities in the baseline and some of the effects in the baseline may have effects on listed species above the individual level. This Opinion describes these activities’ effects in the sections below.

Status of Johnson’s Seagrass in the Action Area

Based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of the species from Jupiter Inlet to Virginia Key, at least during periods of relatively good environmental conditions and no significant large-scale disturbances (NMFS 2007). The largest reported contiguous meadow of Johnson’s seagrass in the southern range was observed in Lake Worth Lagoon and was estimated to be 30 acres (Kenworthy 1997).

The seagrass survey conducted for these projects found a combined total of 10.27 acres of seagrass that would be impacted in the action area. The USACE determined approximately 2.6 acres of Johnson’s seagrass would be affected by the proposed dredging (Table 1). The surrounding area within the Lake Worth Lagoon contains vast mixed seagrass beds containing Johnson’s seagrass. As Johnson’s seagrass occurs throughout the areas to be dredged in various concentrations, to be conservative, we consider the entire 2.6 acres to be Johnson’s seagrass habitat.

Table 1. Resource impacts for the 3 related projects

Resource Impacts	Riviera Beach Facility	West Palm Beach Facility	FIND ICW Deepening	Total (acres)
Seagrass	3.99	0.46	5.82	10.27
Johnson’s seagrass	1.93	0.46	0.21	2.6
Hardbottom	0	0	0.15	0.15

Factors Affecting Johnson’s Seagrass in the Action Area

A wide range of activities funded, authorized, or carried out by federal agencies may affect the essential habitat requirements of Johnson’s seagrass. These include dredging, dock/marina construction, boat shows, bridge/highway construction, residential construction, and shoreline stabilization. Other federal actions (or actions with a federal nexus) that may affect Johnson’s seagrass include actions by the EPA and the USACE to manage freshwater discharges into waterways; regulation of vessel traffic by the USCG; management of protected species by the

USFWS; and authorization of state coastal zone management plans by NOAA's National Ocean Service. Although these actions have probably removed Johnson's seagrass and affected its critical habitat, none of these past actions have jeopardized the continued existence of Johnson's seagrass, or destroyed or adversely modified its critical habitat. The majority of these projects were single- or multi-family dock construction that resulted in a few hundred square feet of impacts to Johnson's seagrass. The majority of the projects resulted in impacts to less than 0.1 acre of Johnson's seagrass or its designated critical habitat. However, a few projects resulted in more significant impacts.

Coastal Construction

Dock construction and dredging within the action area has adversely affected Johnson's seagrass and its habitat, through sedimentation, shading, changes to salinity and depth, and direct removal of the species.

Urban Development

Urban development since the 1960s has affected inshore water quality throughout the range of Johnson's seagrass. However, Woodward-Clyde (1996) believed improvements in erosion and sediment control in association with urban development in the 1980s and 1990s may have been responsible for reduced turbidity in those decades as compared to the previous 2 decades of development. Reductions in seagrasses were apparent in the 1970s, along with areas of highly turbid water. Increases in submerged aquatic vegetation were noted until coverage and density peaked in 1986, albeit at levels remaining below those observed in the decades prior to 1960. In association with upland development, water quality and transparency within the range of Johnson's seagrass are affected by storm water and agricultural runoff, wastewater discharges, and other point and non-point source discharges. The most clearly identified and manageable threat to the survival and recovery of Johnson's seagrass is the possibility of mortality due to reduced salinity over long periods of time. High-volume freshwater discharges from Lake Okeechobee flow downstream to the mouth of the St. Lucie River and have the potential to adversely affect Johnson's seagrass. The Comprehensive Everglades Restoration Plan (CERP) may help to alleviate the frequency of high-volume freshwater discharges from Lake Okeechobee.

State and Federal Activities That May Benefit Johnson's Seagrass in the Action Area

State and federal conservation measures exist to protect Johnson's seagrass and its habitat under an umbrella of management and conservation programs that address seagrasses in general (Kenworthy et al. 2006). These conservation measures must be continually monitored and assessed to determine if they will ensure the long term protection of the species and the maintenance of environmental conditions suitable for its continued existence throughout its geographic distribution.

5 EFFECTS OF THE ACTION

Effects of the action include the direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with the action that will be added to the baseline. Indirect effects are those that are caused by the proposed action and are later in time (i.e., occur after the action is complete), but still are reasonably certain to occur.

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Because we believe these projects are interrelated and interdependent, we have chosen to address them together in this Opinion so that we can analyze the effects of the actions together.

The analysis in this section forms the foundation for our jeopardy analysis. The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the proposed action. Data is limited, so NMFS is often forced to make assumptions to overcome the limits in their knowledge. Sometimes, different analytical approaches may be applied to the same data sets, and produce different results. In those cases, in keeping with the direction from the U.S. Congress to resolve uncertainty in favor of threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], NMFS will generally select the value yielding the most conservative outcome (i.e., would lead to conclusions of higher, rather than lower, risk to endangered or threatened species).

Effects of the Action on Johnson's Seagrass

NMFS believes the proposed action is likely to adversely affect Johnson's seagrass, which is listed as threatened under the ESA. Take resulting from the proposed action is not legally prohibited, and no incidental take statement or reasonable and prudent measures will be issued. However, because the action will result in adverse effects to Johnson's seagrass, we must evaluate whether the action is likely to jeopardize the continued existence of the species.

Direct effects to Johnson's seagrass are associated with the various dredging actions associated with this project that will excavate approximately 10.27 acres of seagrass habitat, which includes 2.6 acres of seagrass beds containing Johnson's seagrass as a monoculture or mixed with other species of seagrass.

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of *future* state, tribal, or local private actions—i.e., that are not already in the baseline—that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA (50 CFR 402.14). Actions that are reasonably certain to occur would include actions that have some demonstrable commitment to their implementation, such as funding, contracts, agreements, or plans.

Within the action area, major future changes are not anticipated in ongoing human activities described in the environmental baseline. The present human uses of the action area, such as commercial shipping, boating, and fishing, are expected to continue, though some may occur at increased levels, frequency or intensity in the near future as are their associated risks of injury or removal of seagrass caused by groundings, propeller scaring, or anchoring. NMFS is not aware of any state, tribal, or local private action that is reasonably certain to occur in the future in the action area.

7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of affected Johnson's seagrass. In Section 5, we outlined how the proposed action can affect Johnson's seagrass and the extent of those effects in terms of estimates of the acreage of seagrass destroyed. Now we turn to an assessment of the species' response to this impact, in terms of overall population effects from the estimated take, and whether those effects of the proposed action, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of the affected species.

It is the responsibility of the action agency to “insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species...” (ESA Section 7(a)(2)). Action agencies must consult with and seek assistance from the Services to meet this responsibility. The Services must ultimately determine in an Opinion whether the action jeopardizes listed species. “To jeopardize the continued existence of any endangered species or threatened species...” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). Accordingly, in making this determination, NMFS must look at whether the action directly or indirectly reduces the reproduction, numbers, or distribution of a listed species. Then, if there is a reduction in one or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

In the following section we evaluate the response of Johnson's seagrass to the effects of the action. The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of Johnson's seagrass. In Section 5, we outlined how the proposed action can affect Johnson's seagrass. Now we turn to an assessment of the species response to these impacts, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of the affected species.

Effect of the Action on Johnson's Seagrass Likelihood of Survival and Recovery in the Wild

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of Johnson's seagrass. In the previous section, we analyzed the effects of the action on Johnson's seagrass. Now we turn to an assessment of the species response to these effects, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the status of the species, the environmental baseline, and the cumulative effects, will jeopardize the continued existence of Johnson's seagrass.

The estimated loss of 2.6 acres of Johnson's seagrass due to the proposed action is a conservative, reasonable worst-case scenario. In terms of the edges of the action area, NMFS

believes Johnson's seagrass is likely to recolonize some of the side slopes of the channels after the dredging is complete based on its life history strategy (i.e., it effectively out-competes other seagrass species in periodically disturbed areas, Durako et al. 2003) in the shallow depth of the dredging area (i.e., less than 12 ft, which is within its known depth range). The loss of 2.6 acres of Johnson's seagrass is a reduction in numbers of the species. However, in terms of adverse effects on a larger, population scale, the Johnson's Seagrass Recovery Team determined that effects of dredging and filling activities are generally local and small-scale in nature and are not considered threats to the survival and recovery of the species because these activities will not individually or cumulatively result in the long-term, large-scale mortality of Johnson's seagrass, particularly in light of its "pulsating patches" life history strategy, discussed in Section 3.2. Thus the loss of 2.6 acres of Johnson's seagrass will not result in long-term mortality either in the immediate action area or on a larger scale, including the large meadows of the species found in Lake Worth Lagoon.

Reproduction will be temporarily reduced by the 2.6-acre reduction in Johnson's seagrass numbers, but NMFS considers that this reproductive loss does not appreciably reduce the likelihood of survival of Johnson's seagrass in the wild. Johnson's seagrass will continue to reproduce and spread because the proposed impacts are expected to be temporary (i.e., Johnson's seagrass is likely to recolonize the shallow areas of the action area after the dredging is complete).

The proposed action will not result in a complete reduction of Johnson's seagrass distribution or fragmentation of the range since we expect Johnson's seagrass will recolonize the shallow areas and will continue to be capable of spreading via asexual fragmentation. Therefore, the reproductive potential of the species in the action area, and in this portion of its range, will persist.

Recovery for Johnson's seagrass, as described in the recovery plan, will be achieved when the following recovery objectives are met: (1) the species' present geographic range remains stable for at least 10 years, or increases; (2) self-sustaining populations are present throughout the range at distances less than or equal to the maximum dispersal distance to allow for stable vegetative recruitment and genetic diversity; and (3) populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition).

NMFS believes that the proposed action will not appreciably reduce the likelihood of recovery of Johnson's seagrass in the wild. NMFS's 5-year review (from 2007) of the status of the species concluded that the first recovery objective has been achieved. In fact, the range has increased slightly northward. The proposed action will not impact the status of this objective. Self-sustaining populations are present throughout the range of the species. The species' overall reproductive capacity will be only minimally reduced by the reduction in Johnson's seagrass numbers and reproduction resulting from the action. The proposed dredging will not lead to separation of self-sustaining Johnson's seagrass patches to an extent that might lead to adverse effects to one or more patches of the species. Similarly, the availability of suitable habitat in which the species can spread/flow in the future will not be adversely affected by the proposed action. Additional habitat will be available at the Old Port Cove seagrass habitat mitigation site. While additional individual impacts may continue to occur, over the last decade the species has

not demonstrated any declining trends. The proposed action will not reduce or destabilize the present range of Johnson's seagrass. Therefore, the project will not appreciably reduce the likelihood of recovery of Johnson's seagrass in the wild.

8 CONCLUSION

NMFS has analyzed the best available data, the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of Johnson's seagrass. Because the proposed action will not reduce the likelihood of survival and recovery of Johnson's seagrass, it is our Opinion that the proposed action is also not likely to jeopardize the continued existence of the species.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help implement recovery plans or to develop information.

NMFS believes the following conservation recommendations are reasonable, necessary, and appropriate to conserve and recover Johnson's seagrass. NMFS strongly recommends that these measures be considered and adopted.

1. NMFS recommends that a report of all current and proposed USACE projects in the range of Johnson's seagrass be prepared and used by the USACE to assess impacts on the species from these projects, to assess cumulative impacts, and to assist in early consultation that will avoid and/or minimize impacts to Johnson's seagrass and its critical habitat. Information in this report should include location and scope of each project and identify the federal lead agency for each project. The information should be made available to NMFS.
2. NMFS recommends that the USACE conduct and support research to assess trends in the distribution and abundance of Johnson's seagrass. Data collected should be contributed to the Florida Fish and Wildlife Conservation Commission's Florida Wildlife Research Institute to support ongoing GIS mapping of Johnson's and other seagrass distribution.
3. NMFS recommends that the USACE, in coordination with seagrass researchers and industry, support ongoing research on light requirements and transplanting techniques to preserve and restore Johnson's seagrass, and on collection of plants for genetics research, tissue culture, and tissue banking.
4. NMFS recommends that the USACE prepare an assessment of the effects of other actions under its purview on Johnson's seagrass for consideration in future consultations.

5. NMFS recommends that the USACE promote the use of the October 2002, *Key for Construction Conditions for Docks or other Minor Structures Constructed in or over Johnson's Seagrass* as the standard construction methodology for proposed docks located in the range of Johnson's seagrass.
6. NMFS recommends that the USACE review and implement the recommendations in the July 2008 report, *The Effects of Docks on Seagrasses, With Particular Emphasis on the Threatened Seagrass, Halophila johnsonii* (Landry et al. 2008).
7. NMFS recommends that the USACE review and implement the Conclusions and Recommendations in the October 2008 report, *Evaluation of Regulatory Guidelines to Minimize Impacts to Seagrasses from Single-Family Residential Dock Structures in Florida and Puerto Rico* (Shafer et al. 2008).

10 REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) The amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of take is exceeded, USACE must immediately request reinitiation of formal consultation.

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STANDARD MANATEE CONDITIONS FOR IN-WATER WORK 2011

The permittee shall comply with the following conditions intended to protect manatees from direct project effects:

- a. All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.
- b. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.
- c. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.
- d. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.
- e. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida, and to FWC at ImperiledSpecies@myFWC.com
- f. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 ½" by 11" explaining the requirements for "Idle Speed/No Wake" and the shut down of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at MyFWC.com/manatee. Questions concerning these signs can be sent to the email address listed above.

CAUTION: MANATEE HABITAT

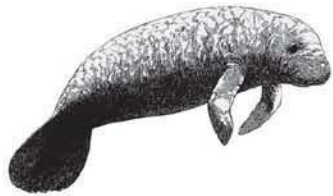
All project vessels

IDLE SPEED / NO WAKE

When a manatee is within 50 feet of work
all in-water activities must

SHUT DOWN

Report any collision with or injury to a manatee:



Wildlife Alert:

1-888-404-FWCC(3922)

cell *FWC or #FWC



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

- a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.
- b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.
- c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.
- d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.
- e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.
- f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.
- g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

O:\forms\Sea Turtle and Smalltooth Sawfish Construction Conditions.doc



FIND
MITIGATION AND MONITORING
PLAN for SUGAR SAND

Prepared for
US Army Corps of Engineers
Permit No. SAJ-2012-01719

August 2014

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ATTACHMENT 1: UMAM SHEETS

SUGAR SANDS ARTIFICIAL REEF MITIGATION/MONITORING PLAN

SECTION 1: OBJECTIVE

The purpose of the Florida Inland Navigation District (FIND) project is to modify the Federal channel north of Palm Beach Harbor to provide navigation access for larger and deeper-draft vessels to interior berthing, testing, and repair marina facilities located north of the Palm Beach Harbor in Lake Worth Lagoon (LWL). The need for deepening comes from the desire of existing facilities to expand access for larger/deeper-draft vessels requiring deeper water depths to safely navigate the interior Intracoastal Waterway (ICW) area. The design depth of the ICW in this area is -10 feet mean low water. The project would deepen 3,555 linear feet of the ICW to -15 foot depths with 2 foot over-dredge. As a result of the dredging, impacts would occur to 0.15 acre of hardbottom and 5.82 acres of seagrasses within the channel.

To offset the loss of hardbottom and seagrasses as a result of the ICW dredging project, FIND would create a hardbottom reef and restore seagrass habitat. The focus of this mitigation and monitoring plan is the creation of an artificial reef, which is proposed at Sugar Sands Artificial Reef Area (Sugar Sands) in Palm Beach County. A separate mitigation and monitoring plan has been completed for the seagrass restoration project, which is proposed at the Snook Island Natural Area.

SECTION 2: SITE SELECTION

To offset lost ecological functions resulting from removal of hardbottom as part of the ICW channel deepening project around Peanut Island, FIND proposes to construct an artificial reefs site in (to the extent practical) locations comparable to the impact. As the project impacts occur in Lake Worth Lagoon, FIND proposes construction of artificial reefs in the Palm Beach County Sugar Sands Artificial Reef Area (Figure 1).

The Sugar Sands Artificial Reef site is located on the eastern side of Lake Worth Lagoon approximately 2.25 miles north of the Palm Beach inlet. The site is a ten (10) acre previously dredged hole approximately 2,000 linear feet long by 200 linear feet wide. The dredg hole is approximately 25-feet deep mean low water. Reef materials have been placed within 7 acres of the site with the current artificial reefs very successful. The site is highly successful as it is heavily utilized by marine fauna due to the close proximity to the inlet.

Figure 1. Location of Sugar Sands



SECTION 3: SITE PROTECTION INSTRUMENT

The Sugar Sands artificial reef site is located in tidally influenced navigable waters. Work within this area requires a Department of the Army (DA) permit as well as a Florida Department of Environmental Protection (FDEP) permit. Activities within the Sugar Sands site also require a proprietary authorization from FDEP as the site is sovereign submerged lands owned by the Board of Trustees of the Internal Improvement Trust Fund pursuant to Article X, Section 11 of the Florida Constitution, and Sections 253.002 and 253.77, Florida Statute.

Palm Beach County's Board of County Commissioners created the Artificial Reef and Environmental Enhancement Committee (AREEC) in 1985, in which the committee makes recommendations for artificial reef and estuarine enhancement projects. Because Palm Beach County's Environmental Resources Management (ERM) manages the artificial reef program for which the Sugar Sands was created, special conditions would be placed in the permit that ensure compliance with 33 CFR 332.7(a). FIND, in cooperation with the Palm Beach County's ERM and the AREEC, shall implement and maintain in perpetuity the proposed artificial reef within the Sugar Sands site. The U.S. Army Corps of Engineers (Corps) shall be provided access to the reefs as necessary to inspect for permit compliance. Palm Beach County will notify the Corps in writing no less than 60 days before an action is taken to establish any other legal claims over the Sugar Sands site, as well as any changes in management plans, statutes, regulations or agencies needs or missions which result in any incompatible uses within Sugar Sands. If Palm Beach County is authorized an incompatible use of the Sugar Sands reef site for this project, an alternative compensatory mitigation plan shall be provided to the Corps for approval that would offset the losses in functions resulting from the incompatible use. Palm Beach County shall comply with any timelines as determined by the Corps for implementation of remedial actions required by the Corps.

SECTION 4: BASELINE INFORMATION

To document pre-construction conditions, FIND shall:

- a. Conduct a pre-construction survey where the artificial reef would be located indicating baseline conditions including the substrate, the location of any aquatic resources or reefs located within a 50-foot perimeter, water clarity, water depths, and any other relevant information.

- b. Perform a time-zero monitoring event of the artificial reef area(s) within 30 days of completion of the construction of the reef.

c. Submit the time-zero report to the Corps within 30 days of completion of the monitoring event. The report will include at least one paragraph depicting pre-construction and baseline conditions of the mitigation site(s) prior to initiation of the compensatory mitigation objectives and a detailed plan view drawing of all created, enhanced and/or restored mitigation areas.

SECTION 5: DETERMINATION OF CREDITS

The project impacts and proposed reef mitigation site were evaluated using the Uniform Mitigation Assessment Methodology (UMAM). The impacts to 0.15 acre of hardbottom would be offset through the creation of 0.20 acre reef at Sugar Sands Artificial Reef Area. The pre- and post-construction UMAM analysis worksheets are included as Attachment 1. The UMAM analysis is summarized below (Table 1).

Table 1. FIND Seagrass Impact UMAM Analysis Summary

	Acreage	Location Pre/Post	Water Env Pre/Post	Community Pre/Post	Timelag /Risk	Functional loss/gain
Hardbottom Impact	0.15	6/4	6/4	7/2		-0.045
Hardbottom Mitigation	0.20	7/8	7/8	0/7	1.07/1.25	+0.045
Total						0.0

SECTION 6: MITIGATION WORK PLAN

The Sugar Sands Artificial Reef Area has current permits from the FDEP and Corps for use as an artificial reef site. FIND proposes to add artificial reef substrate (surplus precast concrete structures) to an area of the Sugar Sands site not previously used. Approximate location of the reef is shown in Figure 2. FIND contractors will work closely with Palm Beach County to define suitable placement area acceptable to Palm Beach. Magnetometer scans of the area will locate any buried utilities, which the project construction will avoid. A diver visual inspection will verify that the site does not include any artificial substrate and comprises clean sand (no seagrass). At an appropriate upland staging area and prior to deployment, FIND will stockpile material conforming to the standards for artificial reef substrate in the Fish and Wildlife Conservation Commission (FFWCC) recommended: **Guidelines for Marine Artificial Reef Materials 2nd Edition** accessible at:

http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_2004.pdf

The material in the staging area will be available for inspection by federal and state agency staffs 30 days before installation. The placement site borders will remain at least 75 foot from existing artificial reefs. FIND and its contractors will coordinate closely with Palm Beach County Environmental Program Supervisor during the site selection process. FIND will submit detailed artificial reef construction plans and an approval letter from Palm Beach County to the Corps at least 30 days prior to construction.

Construction

The construction crew will include divers and boat based workers. Buoys placed prior to the arrival of the barge will mark the corners of the site. The barge will locate so that it is anchored in the center of the artificial reef site. Placement of buoys and barge location will employ GPS with sub-meter accuracy. The barge operator will then deploy the materials from the edge of the barge using a forklift or other suitable equipment to push the material into the water one or a few pieces at a time. Divers will periodically inspect the deployment results to verify that the material remains within the site boundaries and remain within an elevation of ten feet. As the Sugar Sands site lies at 25 – 30 feet deep, the elevation meets the criteria in 62-341.600 F.A.C. General Permit for the construction of artificial reefs 1(d) governing the elevation of the reef. The objective of the deployment is to create a relatively contiguous mass of artificial reef material covering 1.20 acres (8,712 square feet). At completion of construction all buoys will be removed. Construction is expected to require one day, but may extend to a second day depending on the method of deployment and the weather.

During construction, best management practices will include the use of one full time, independent, U.S. Fish and Wildlife Service (FWS)/National Marine Fisheries Service (NMFS)-approved observer for manatees, marine turtles, and smalltooth sawfish. If any of these species comes within 50 foot of the barge, all work must stop until the animal has moved away of its own accord. The contractor will not harass or otherwise act in ways meant to cause the animal to move away. Work will recommence after the animal has moved away.

The site substrate is clean sand and the material is clean concrete. When the material falls to the bottom, very localized and temporary turbidity may occur, but the work will generate no turbidity plume. Therefore, no turbidity curtains or monitoring is warranted. Final inspection of the deployment (which will occur within five working days of deployment) will include GPS location of the outer edges of the artificial reef and final elevations, as well as any other notes or observations. A final report submitted to the state and federal environmental permitting staffs and Palm Beach County will detail the construction activity and final inspection findings.

Within 30 days of placement of the reef material, FIND “shall notify the National Ocean Service, National Oceanographic and Atmospheric Association, U.S. Department of Commerce, Rockville, Maryland, and the Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, via e-mail at artificialreefdeployments@myfwc.com of the precise location of the reef” (62-341.600 General Permit for the Construction of Artificial Reefs).

SECTION 7: MAINTENANCE PLAN

The artificial reef will require little if any maintenance. A wide variety of species, including hard corals, are expected to colonize the reef materials and over time alter appearance and physical linkages between the separate components of the reef. Maintenance as such is not anticipated, although long-term management of the site may include some maintenance responsibilities.

The monitoring dives will include inspection of the physical structure of the site and report if any maintenance actions are necessary. The Palm Beach County Reef Research Team, which was formed in 1991, dives the Palm Beach County reefs (both natural and artificial) and monitors the marine life to provide data for management decisions. After regulatory success criteria are achieved, the Palm Beach County Reef Research Team will include the FIND reef in the monitoring of the Sugar Sands Artificial Reef site monitoring and provide reports to Palm Beach County on potential maintenance issues. Palm Beach County shall provide any necessary recommendations to FIND for implementation.

SECTION 8: PERFORMANCE STANDARDS

Success Criteria

Evaluation of the artificial reef(s) success as mitigation will occur via the results of the annual biological monitoring. A UMAM analysis will be performed using the collected quantitative and qualitative data from both the biological monitoring and mitigation reef(s) monitoring. If UMAM scoring indicates that ecological functions have been effectively offset, the mitigation reef(s) will be deemed a success. UMAM factors include acreages of both impact and mitigation sites, as well as scoring of ecological functions lost or provided at the impact and mitigation sites, respectively. Functions will be assumed offset if (1) 80% of species found in the impact site shall be present in the mitigation site by the time of the completion of the monitoring period; and (2) the percent cover by the major groups of organisms (functional groups) in the mitigation site shall be no less that it was in the impact site.

Performance Standard Timeframe

The mitigation project will result in a sustainable hardbottom community. The mitigation area will meet the success criteria three or fewer years after completion of construction. If after three (3) annual monitoring events, it is determined that the installed mitigation reef(s) do not adequately offset lost ecological functions, FIND will consult with the Corps, identify probable causes, submit a plan with the necessary corrective actions identified, implement those corrective actions once approved by the Corps, and extend monitoring for an additional period of time identified as part of the corrective action plan.

Reporting

All data deliverables shall be provided within 90 days after completion of each mitigation reef survey. The deliverables will include the following data on CD:

- all digital video transects and frame-grabbed images from all transects
- PointCount files and associated data (i.e. PTS files, MGR files, cd.dat files)
- Excel spreadsheets of PointCount data (raw data and summary files)
- Excel spreadsheets of *in situ* quadrat data
- Spatial GIS shapefiles of transects

A report summarizing the monitoring (permanent transects, quadrats) and analyses will be prepared. The report shall include appropriate graphics/tables, statistical analysis of the collected data, and assessment of ecological functions provided by the mitigation as compared to those provided at the impact site. The report shall be provided within 90 days after completion of the survey in both hard copy and digital format.

SECTION 9: MONITORING REQUIREMENTS

The baseline monitoring effort, which will establish baseline conditions and sampling locations for success monitoring, will occur within 30 days post-construction. Baseline efforts will include:

- Establishment of four fixed monitoring transects and four permanent quadrat sampling sites along each transect.
- Collection of video along each transect and photographs at each of four fixed quadrat monitoring locations along each transect. Transect locations shall be preselected at the post-construction baseline monitoring effort to span the east-west and north-south dimensions of the reef.

Approximately 50 non-overlapping frame-grabbed images will be extracted from each transect video. A unique set of 20 random points shall be generated at the time of

frame-grabbing and stored with each set of images so that the same points are assessed during each monitoring event. This also ensures that each person examining a particular image will view the same points, thereby allowing for double-blind counting for quality assurance and control purposes. Ten percent (10%) of the images shall be counted by two scorers to assess inter-observer variability. Calculation of percent biological cover (projected to the surface) will be performed for each image according to the following functional groups/categories:

- macroalgae (identification and percent cover of two dominant species within quadrat),
- microalgae/cyanobacteria,
- encrusting calcareous algae, sponges (genus level), with a separate assessment of percent,
- cover of boring sponge (*Cliona* spp),
- tunicates (with identification of dominant genera),
- zoanthids (genus level), hydroids,
- wormrock (*Phragmatopoma lapidosa*),
- octocorals (genus level),
- scleractinian corals (species level),
- solitary tunicates, urchins, and
- holothuroids within the quadrat.

The remainder of each video transect shall be reviewed for qualitative changes in benthic community cover/composition in comparison to the pre-construction surveys, previous annual surveys, and the reference sites.

During each survey, a 0.25 square meter (0.5 m by 0.5 m) gridded quadrat will be sampled by the diver/biologist at each location selected at the baseline monitoring event. A list of the locations of the quadrats along each transect with a description of the quadrat location/benthic community shall be provided to the Corps after transect establishment.

Within each quadrat, visual estimate of percent cover and genus/species identification shall be performed *in situ* for the following functional groups:

- macroalgae (identification and percent cover of two dominant species within quadrat),
- microalgae/cyanobacteria,
- encrusting calcareous algae, sponges (genus level), with a separate assessment of percent

- cover of boring sponge (*Cliona* spp),
- tunicates (with identification of dominant genera),
- zoanthids (genus level), hydroids,
- wormrock (*Phragmatopoma lapidosa*),
- octocorals (genus level), and
- scleractinian corals (species level).
- solitary tunicates, urchins, and
- holothuroids within the quadrat.

Individual counts shall be conducted for all octocorals, scleractinian corals, and sponges (not including *Cliona* spp., which shall be assessed for percent cover). Maximum and average algal height of the two dominant microalgae species shall also be recorded. Average algal height shall be estimated by five measurements.

The maximum physical relief of hardbottom from the lowest point to highest point in the quadrant shall be measured to the nearest centimeter.

Success monitoring will occur annually for at least three (3) years post-construction. Because artificial reefs are among the most common type of mitigation that successfully offsets loss of ecological functions due to hardbottom impacts, the time lag was determined to be short (3 years) to replace lost ecological functions for the relatively simple macroalgae / turf algae dominated community found in the impact areas. Note that artificial reefs at the proposed site have developed coral reef communities. Based on those results, the proposed artificial reefs are expected eventually to provide much more complex hardbottom habitat than that lost in the channel deepening.

Each transect shall be sampled using digital video in progressive scan mode, and survey date and location coordinates will be superimposed on the final deliverable. The diver shall swim at a speed of approximately 20 meters/6 minutes (~3.5 meters/minute) with a constant camera distance of 25 cm above bottom during the portions of the transect to be quantitatively analyzed. For the remainder of the 150-meter transect, the diver shall swim at a speed of 20 meters/5 minutes (~4-5 meters/minute) with a constant camera distance of 25 cm. If the diver is moved off the transect by surge or current, the diver shall return to the point where he/she was disturbed by the wave action, and resume filming at that point. The video transects shall be reviewed during the course of the survey to ensure that there are no gaps in the data due to diver error and that the quality of the video is acceptable for video analysis. Any missing video transect data or poor quality video shall be re-filmed during the course of the event.

Landscape panoramic views shall be recorded with the digital video camera at the start

and end of each transect, and at each interruption of the transect by a sand gap/recommencement at the start of the next piece of substrate. Additionally, close-up video of the tag marking the eyebolt at the start and end of each transect shall be filmed for a frame of reference for the observer viewing the video record. Close-up digital still video and/or photographs shall be obtained of representative benthos along each transect to aid in identification during video analysis. Still photographs shall be obtained using the digital video camera or digital still camera at all quadrat locations and hard coral colonies (if observed) along the transect. Voucher sampling of macroalgae shall be conducted as needed to assist with video identification of macroalgae genera.

The Permittee shall:

- a. Perform a time-zero monitoring event and submit to the Corps.
- b. Submit annual monitoring of the reef areas for 3 years of monitoring.

SECTION 10: LONG-TERM MANAGEMENT PLAN

FIND has the responsibility to provide long-term management for their artificial reef. This will consist of periodic coordination with Palm Beach County staff to identify any issues with the FIND reef that might require resolution. The county receives regular input from the diving public on Sugar Sands and other artificial reef sites and is expected to report to FIND information regarding the FIND reef. Should a boating accident, trash spill, or other event negatively impact the FIND reef, FIND will coordinate with the county support the actions necessary to recover the pre-event quality of the FIND reef.

SECTION 11: ADAPTIVE MANAGEMENT PLAN

If the compensatory mitigation fails to meet the performance standards within the specified timeframes, the compensatory mitigation will be deemed unsuccessful. Within 60 days of notification by the Corps that the restoration work is unsuccessful, the Permittees shall submit to the Corps an analysis of the mitigation area to include a re-evaluation of the UMAM scores and whatever success may have been achieved at the site. The re-evaluation will detail whether sufficient lift was accomplished at the site to offset the project's impacts to seagrasses. In the event that the credits generated at the site fail to account for the positive lift it was expected to create, an alternate compensatory mitigation proposal sufficient to offset the authorized impacts under this permit is required that will include additional mitigation to compensate for any loss of aquatic environment functions associated with the unsuccessful compensatory mitigation activities. The Corps reserves the right to fully evaluate, amend, and approve

or reject the alternate compensatory mitigation proposal or require the Permittee to purchase mitigation bank credits. Within 120 days of Corps approval, the Permittee will complete the alternate compensatory mitigation proposal. Impacts will only be offset with in-kind mitigation.

The same assessment process of an annual monitoring effort, assessment of the data with respect to the impact site and as appropriate the adjacent artificial reefs and development of recommendations for site improvement (if any) will occur annually until the success criteria are achieved. In the event that adaptive management is required, the adjacent reefs can provide comparison sites for a better understanding of the colonization occurring at the FIND reef as the other component of information necessary to develop adaptive management recommendations.

SECTION 12: FINANCIAL ASSURANCES

FIND is a permanent, special state taxing District of the continued management and maintenance of the Atlantic Intracoastal Waterway, created by the Florida Legislature. FIND is the local sponsor of the federal navigation project known as the Florida ICW. As an independent taxing authority FIND has the financial means to support and/or perform any necessary actions to meet the permit requirements associated with the artificial reef FIND will construct as part of the permit for deepening a portion of the ICW around Peanut Island in Lake Worth Florida.

Coastal Zone Management

Issuance of this authorization also constitutes a finding of consistency with Florida's Coastal Zone Management Program, as required by Section 307 of the Coastal Zone Management Act.

Water Quality Certification

This permit also constitutes a: water quality certification under Section 401 of the Clean Water Act, 33 U.S.C. 1341

Other Authorizations

You are advised that authorizations or permits for this activity may be required by other federal, state, regional, or local entities including but not limited to local governments or municipalities. This permit does not relieve you from the requirements to obtain all other required permits or authorizations.

The activity described may be conducted only in accordance with the terms, conditions and attachments contained in this document. Issuance and granting of the permit and authorizations herein do not infer, nor guarantee, nor imply that future permits, authorizations, or modifications will be granted by the Department.

PERMIT /SOVEREIGNTY SUBMERGED LANDS CONDITIONS

The activities described must be conducted in accordance with:

- **The Specific Conditions**
- **The General Conditions**
- **The General Conditions for Sovereignty Submerged Lands Authorization**
- **The limits, conditions and locations of work shown in the attached drawings**
- **The term limits of this authorization**

You are advised to read and understand these conditions and drawings prior to beginning the authorized activities, and to ensure the work is conducted in conformance with all the terms, conditions, and drawings herein. If you are using a contractor, the contractor also should read and understand these conditions and drawings prior to beginning any activity. Failure to comply with these conditions, including any mitigation requirements, shall be grounds for the Department to revoke the permit and authorization and to take appropriate enforcement action.

Operation of the facility is not authorized except when determined to be in conformance with all applicable rules and this permit and sovereignty submerged lands authorization, as described.

SPECIFIC CONDITIONS- PROJECT FORMS & ATTACHMENTS

(1) The attached 1-page permit checklist; the attached project drawings (sheets 1 through 11); the attached 1-page “Standard Manatee Conditions for In-Water Work, 2011” (Exhibit A); the attached 1-page Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet (Exhibit B); the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Exhibit C) and DEP forms 62-330.310(3), 62-330.310(1); 62-330.310(2); 62-330.340(1); and 62-330.350(1), which may be downloaded at <http://www.dep.state.fl.us/water/wetlands/erp/forms.htm> become part of this permit. If the permittee does not have access to the Internet, please contact the Department at (561) 681-6636 to request the aforementioned forms and/or document(s).

(2) If the attached permit drawings conflict with the specific conditions, then the specific conditions shall prevail.

SPECIFIC CONDITIONS - PRIOR TO CONSTRUCTION

(3) After selection of the contractor to perform the authorized activities and prior to the initiation of any work authorized by this permit, the permittee (or authorized agent) and the contractor shall attend a pre-construction conference with a representative of the Department. It shall be the responsibility of the permittee to contact this project's compliance project manager, Melissa Gil, by email Melissa.Gil@dep.state.fl.us, or by phone (561) 681-6636, to schedule the pre-construction conference.

(4) The permittee shall ensure that the permit conditions are explained to all construction personnel working on the project and for providing each contractor and subcontractor with a copy of this permit before the authorized work begins.

(5) Prior to the initiation of any dredging authorized by this permit, floating turbidity curtains with weighted skirts that extend to within one foot of the bottom shall be placed around the project site, when feasible. Additionally, staked erosion control devices shall also be installed around the perimeter of the proposed spoil management area to ensure that turbid discharges into wetlands or surface waters do not occur.

(6) The permittee shall be required to submit a Maintenance of Marine Traffic Plan. This plan is to be approved prior to issuance of the Notice to Proceed, must clearly demonstrate how the contractor will avoid disruption of ongoing traffic to the maximum extent possible.

(7) Prior to construction, the permittee shall obtain a minor modification to SFWMD Permit No. 50-04766-P. The permit modification shall indicate the number of seagrass Functional Gain Units required for the authorized activities in this permit, subtracted from the total available number of seagrass Functional Gain Units for the Snook Island Natural Area project, as funded by F.I.N.D.

SPECIFIC CONDITIONS – IMPACTS & MITIGATION REQUIREMENTS

(8) The authorized activities shall impact 5.82 acres of seagrass. To offset unavoidable impacts to 5.82-acres of seagrass habitat, the permittee shall use a total of 1.397 Functional Gains Units from the existing Snook Islands Natural Area (SINA) as permitted in SFWMD Permit No. 50-04766-P, per the attached 1-page Florida Inland Navigation District- Snook Island Mitigation Area Seagrass Balance Sheet (Exhibit B).

(9) Additionally, the authorized activities shall impact 0.15 acres of hardbottom habitat. To offset unavoidable impacts to 0.15-acres of hardbottom habitat, within 30 days of commencing dredging activities, the permittee shall install 0.12 acres (5,227 sq.ft.) of artificial reef substrate (surplus precast concrete structures) to an area within the Palm Beach County Sugar Sands Artificial Reef Area, in accordance with the attached 11-page Peanut Island ICWW Deeping Project Hardbottom Mitigation Plan (Exhibit C).

(10) Within 30 days after completing construction of the artificial reef, the permittee shall submit to the Department a Time Zero report. The report shall include the construction date and the total volume of material installed. The report shall contain photographs, taken from referenced locations, to represent the entire site. Additionally, a drawing shall be included to show the location and direction of the camera. Subsequent monitoring reports shall be submitted annually for a period of 3 years, the first report being due one year after the Time Zero Report. The annual reports shall include the number of functional groups, a list of all species observed, the percent-coverage of native species observed, and explanations if survivorship is trending toward failure. The reports shall include photographs from the locations referenced in the Time Zero Report. The reports shall be sent via e-mail to the Department's assigned Compliance Project Manager, Melissa Gil (Melissa.Gil@dep.state.fl.us).

(11) In order for the artificial reef to be deemed successful, the artificial reef must achieve a minimum of 80% of major groups of organisms (functional groups) coverage that is currently found at the impact site and shall be present by the end of the first 3 years after placement.

(12) The responsibility to determine if the artificial reef is meeting the permit-specified success criteria shall not fall solely on the Department. Within the first 2 years after placement, if the permittee becomes aware that the project is not meeting the success criteria and probably will not meet the criteria based on site observations, then the permittee shall notify the Department at the email address in Specific Condition No. 3. The permittee shall then submit an alternative planting plan to the Department for review and approval.

SPECIFIC CONDITIONS – CONSTRUCTION ACTIVITIES

(13) The work authorized by this permit shall not be conducted on any property, other than that owned by the permittee, without the prior written approval of that property owner.

(14) All storage or stockpiling of tools or materials (i.e. lumber, pilings, debris, etc.) shall be limited to uplands. All construction equipment/tools and materials shall be transported to and from the site upland roadways and all equipment/tools and materials shall be stored on the uplands.

(15) Best management practices shall be employed during all phases of this project. All water bodies, adjacent submerged aquatic vegetation, and/or adjacent wetland resources outside the specific limits of construction authorized by this permit shall be protected from erosion, siltation, sedimentation, and/or scouring.

(16) A temporary mixing zone is authorized with this permit to occur up to 150-meters down current of the dredging location. If turbidity is visible outside of the 150-meter mixing zone, then turbidity levels shall be monitored as required in Specific Condition No's. 20 through 22.

(17) Dredging shall be conducted from a shallow draft barge with a fully loaded draft of no more than 8 feet. All watercraft associated with the construction of the permitted structure shall only operate within waters of sufficient depth (one-foot clearance from the deepest draft of the vessel to the top of submerged resources) so as to preclude bottom scouring, prop dredging, or damage to submerged resources.

(18) The material shall be mechanically or hydraulically dredged and deposited onto the existing Peanut Island DMMA. Return water shall not be discharged into areas outside of the authorized mixing zone.

(19) All areas to be dredged shall be in accordance with the attached permit drawings and shall not exceed the areas and depths indicated on those drawings.

SPECIFIC CONDITIONS – MONITORING/REPORTING REQUIREMENTS

(20) Turbidity levels outside the 150-meter temporary mixing zone shall not exceed 29 NTU's above background levels. The following measures shall be taken immediately by the permittee whenever turbidity levels within waters of the State surrounding the project site exceed 29 NTUs above background:

- a. Notify the Department at (561) 681-6636 at the time the violation is first detected.
- b. Immediately cease all work contributing to the water quality violation.
- c. Stabilize all exposed soils contributing to the violation. Modify the work procedures that were responsible for the violation, install more turbidity containment devices, and repair any non-functional turbidity containment devices.
- d. Perform turbidity monitoring.
- e. Resume construction activities once turbidity levels outside turbidity curtains fall below 29 NTUs.

(21) Turbidity Monitoring. Water turbidity levels shall be monitored every four hours if a turbidity plume is observed outside the limits of the authorized mixing zones. Samples shall be taken one foot above the bottom, mid-depth, and one-foot below the surface at monitoring stations located as follows:

- a. Approximately 100 feet up-current of the work sites and clearly outside the influence of construction activities. (This shall serve as the natural background sample against which other turbidity readings shall be compared.)
- b. Immediately outside the authorized 150-meter mixing zone surrounding the work sites and within the densest portion of any visible turbidity plume. (This sample shall serve as the compliance sample.)

(22) Turbidity Monitoring Reports. During dredging activities, the permittee or permittee's contractor shall collect the following turbidity monitoring data at the frequency and water depths directed by Specific Condition #21:

- a. Date and time of sampling event
- b. Turbidity sampling results (background NTUs, compliance NTUs, and the difference between them)
- c. Description of data collection methods
- d. An aerial map indicating the sampling locations
- e. Depth of sample(s)
- f. Weather conditions at times of sampling
- g. Tidal stage and direction of flow

Data shall be collected in a turbidity log and shall include a statement by the individual responsible for implementation of the sampling program attesting to the authenticity, precision, limits of detection, and accuracy of the data. The turbidity log shall be scanned and sent on a weekly basis to the Department’s compliance project manager, Melissa Gil, by email at Melissa.Gil@dep.state.fl.us. The subject line of the email shall include the project name, permit number, and the title “Turbidity Monitoring Reports.”

SPECIFIC CONDITIONS – MANATEE CONDITIONS

(23) During all in-water work, the permittee shall comply with the standard manatee protection construction conditions listed in the attached 1-page “Standard Manatee Conditions for In-Water Work, 2011”.

(24) To reduce the possibility of injuring or killing a manatee during construction, dredging shall not be performed during the following time of year: November 15- March 31.

(25) When in water work is being performed, at least one person shall be designated as a manatee observer. That person shall have experience in manatee observation and be equipped with polarized sunglasses to aid in observation. The manatee observer must be on site during all in-water construction activities and will advise personnel to cease operation upon sighting a manatee within 50 feet of any in-water construction activity. Movement of a work barge or other associated vessels, shall not be performed after sunset, when the potential of spotting manatees is negligible.

SPECIFIC CONDITIONS – PROTECTION OF HISTORICAL RESOURCES

(26) If prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoes, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the immediate vicinity of such discoveries. The permittee, or other designee, should contact the Florida Department of State, Division of Historical Resources, Review and Compliance Section at 850/245-6333 or 800/847-7278, as well as the appropriate permitting agency office. Project activities should not resume without verbal and/or written authorization from the Division of Historical Resources. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.

GENERAL CONDITIONS FOR INDIVIDUAL PERMITS

The following general conditions are binding on all individual permits issued under chapter 62-330, F.A.C., except where the conditions are not applicable to the authorized activity, or where the conditions must be modified to accommodate project-specific conditions.

(1) All activities shall be implemented following the plans, specifications and performance criteria approved by this permit. Any deviations must be authorized in a permit modification in accordance with Rule 62-330.315, F.A.C. Any deviations that are not so authorized may subject the permittee to enforcement action and revocation of the permit under Chapter 373, F.S.

(2) A complete copy of this permit shall be kept at the work site of the permitted activity during the construction phase, and shall be available for review at the work site upon request by the Agency staff. The permittee shall require the contractor to review the complete permit prior to beginning construction.

(3) Activities shall be conducted in a manner that does not cause or contribute to violations of state water quality standards. Performance-based erosion and sediment control best management practices shall be installed immediately prior to, and be maintained during and after construction as needed, to prevent adverse impacts to the water resources and adjacent lands. Such practices shall be in accordance with the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (Florida Department of Environmental Protection and Florida Department of Transportation June 2007), and the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual (Florida Department of Environmental Protection, Nonpoint Source Management Section, Tallahassee, Florida, July 2008), which are both incorporated by reference in subparagraph 62-330.050(9)(b)5., F.A.C., unless a project-specific erosion and sediment control plan is approved or other water quality control measures are required as part of the permit.

(4) At least 48 hours prior to beginning the authorized activities, the permittee shall submit to the Agency a fully executed Form 62-330.350(1), "Construction Commencement Notice," [October 1, 2013], which is incorporated by reference in paragraph 62-330.350(1)(d), F.A.C., indicating the expected start and completion dates. A copy of this form may be obtained from the Agency, as described in subsection 62-330.010(5), F.A.C. If available, an Agency website that fulfills this notification requirement may be used in lieu of the form.

(5) Unless the permit is transferred under Rule 62-330.340, F.A.C., or transferred to an operating entity under Rule 62-330.310, F.A.C., the permittee is liable to comply with the plans, terms and conditions of the permit for the life of the project or activity.

(6) Within 30 days after completing construction of the entire project, or any independent portion of the project, the permittee shall provide the following to the Agency, as applicable:

- a. For an individual, private single-family residential dwelling unit, duplex, triplex, or quadruplex – "Construction Completion and Inspection Certification for Activities Associated With a Private Single-Family Dwelling Unit" [Form 62-330.310(3)]; or
- b. For all other activities – "As-Built Certification and Request for Conversion to Operational Phase" [Form 62-330.310(1)].
- c. If available, an Agency website that fulfills this certification requirement may be used in lieu of the form.

(7) If the final operation and maintenance entity is a third party:

- a. Prior to sales of any lot or unit served by the activity and within one year of permit issuance, or within 30 days of as-built certification, whichever comes first, the permittee shall submit, as applicable, a copy of the operation and maintenance documents (see sections 12.3 thru 12.3.3 of Volume I) as filed with the Department of State, Division of Corporations and a copy of any easement, plat, or deed restriction needed to operate or maintain the project, as recorded with the Clerk of the Court in the County in which the activity is located.

- b. Within 30 days of submittal of the as-built certification, the permittee shall submit “Request for Transfer of Environmental Resource Permit to the Perpetual Operation Entity” [Form 62-330.310(2)] to transfer the permit to the operation and maintenance entity, along with the documentation requested in the form. If available, an Agency website that fulfills this transfer requirement may be used in lieu of the form.

(8) The permittee shall notify the Agency in writing of changes required by any other regulatory agency that require changes to the permitted activity, and any required modification of this permit must be obtained prior to implementing the changes.

(9) This permit does not:

- a. Convey to the permittee any property rights or privileges, or any other rights or privileges other than those specified herein or in Chapter 62-330, F.A.C.;
- b. Convey to the permittee or create in the permittee any interest in real property;
- c. Relieve the permittee from the need to obtain and comply with any other required federal, state, and local authorization, law, rule, or ordinance; or
- d. Authorize any entrance upon or work on property that is not owned, held in easement, or controlled by the permittee.

(10) Prior to conducting any activities on state-owned submerged lands or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund, the permittee must receive all necessary approvals and authorizations under Chapters 253 and 258, F.S. Written authorization that requires formal execution by the Board of Trustees of the Internal Improvement Trust Fund shall not be considered received until it has been fully executed.

(11) The permittee shall hold and save the Agency harmless from any and all damages, claims, or liabilities that may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment or use of any project authorized by the permit.

(12) The permittee shall notify the Agency in writing:

- a. Immediately if any previously submitted information is discovered to be inaccurate; and
- b. Within 30 days of any conveyance or division of ownership or control of the property or the system, other than conveyance via a long-term lease, and the new owner shall request transfer of the permit in accordance with Rule 62-330.340, F.A.C. This does not apply to the sale of lots or units in residential or commercial subdivisions or condominiums where the stormwater management system has been completed and converted to the operation phase.

(13) Upon reasonable notice to the permittee, Agency staff with proper identification shall have permission to enter, inspect, sample and test the project or activities to ensure conformity with the plans and specifications authorized in the permit.

(14) If any prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoes, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, work involving subsurface disturbance in the immediate vicinity of such discoveries shall cease. The permittee or other designee shall contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section, at (850) 245-6333 or (800) 847-7278, as well

as the appropriate permitting agency office. Such subsurface work shall not resume without verbal or written authorization from the Division of Historical Resources. If unmarked human remains are encountered, all work shall stop immediately and notification shall be provided in accordance with Section 872.05, F.S.

(15) 15. Any delineation of the extent of a wetland or other surface water submitted as part of the permit application, including plans or other supporting documentation, shall not be considered binding unless a specific condition of this permit or a formal determination under Rule 62-330.201, F.A.C., provides otherwise.

(16) The permittee shall provide routine maintenance of all components of the stormwater management system to remove trapped sediments and debris. Removed materials shall be disposed of in a landfill or other uplands in a manner that does not require a permit under Chapter 62-330, F.A.C., or cause violations of state water quality standards.

(17) This permit is issued based on the applicant's submitted information that reasonably demonstrates that adverse water resource-related impacts will not be caused by the completed permit activity. If any adverse impacts result, the Agency will require the permittee to eliminate the cause, obtain any necessary permit modification, and take any necessary corrective actions to resolve the adverse impacts.

(18) A Recorded Notice of Environmental Resource Permit may be recorded in the county public records in accordance with subsection 62-330.090(7), F.A.C. Such notice is not an encumbrance upon the property.

GENERAL CONDITIONS FOR SOVEREIGNTY SUBMERGED LANDS AUTHORIZATION

Any use of sovereignty submerged lands is subject to the following general conditions are binding upon the applicant and are enforceable under Chapter 253, F.S. and Chapter 258, F.S.

(1) Sovereignty submerged lands may be used only for the specified activity or use. Any unauthorized deviation from the specified activity or use and the conditions for undertaking that activity or use will constitute a violation. Violation of the authorization will result in suspension or revocation of the applicant's use of the sovereignty submerged lands unless cured to the satisfaction of the Board of Trustees.

(2) Authorization under Rule 18-21.005, F.A.C., conveys no title to sovereignty submerged lands or water column, nor does it constitute recognition or acknowledgment of any other person's title to such land or water.

(3) Authorizations under Rule 18-21.005, F.A.C., may be modified, suspended or revoked in accordance with its terms or the remedies provided in Sections 253.04, F.S. and Chapter 18-14, F.A.C.

(4) Structures or activities will be constructed and used to avoid or minimize adverse impacts to resources.

ATTACHMENT G

Impacts of Climate Change on Lake Worth Lagoon

Impacts of Climate Change on Lake Worth Lagoon

1.1 Trends and Projected Future for Hydrology

1.2 Introduction

An underlying assumption of traditional hydrologic frequency analysis is that climate and hence, the frequency of hydrologic events, is stationary or unchanging over time and that historical climate records can be used as a surrogate for future climate projections in water management planning processes. While historical data is essential to understanding current and future climate, nonstationarity in the data (i.e., a changing climate) dictates the use of supplemental information in long-term planning studies. Projections of specific climate changes and associated impacts to local-scale project hydrology that may occur far in the future are uncertain. Therefore, USACE and other resource management agencies require reliable, science-based methods for incorporating climate change information into the assessments that support water resources decisions and actions. Climate change information for hydrologic analyses includes direct changes to hydrology through changes in temperature, precipitation, and other climate variables, as well as subsequent basin responses potentially altered by changes in the primary climate drivers.























In order to evaluate the potential effect of future climate variability on the hydrology within the Lake Worth Lagoon watershed, a qualitative assessment was performed in accordance with Engineering and Construction Bulletin No. 2016-25: Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works, Studies, Designs and Projects. The qualitative analysis required by this ECB includes consideration of both past (observed) changes as well as potential future (projected) changes to relevant hydrologic inputs. The results of this qualitative analysis can indicate the direction of change, but not necessarily the magnitude of that change. In accordance with USACE guidance, the nonstationarity detection tool, and the climate hydrology assessment tool were applied to evaluate the potential impacts of climate change to contributing watershed for the Lake Worth Lagoon CAP project.

1.3 Literature Review

The USACE Institute for Water Resources (IWR) has developed a series of documents that summarize current climate change science with respect to current USACE missions for the 2-digit Hydrologic Unit Code (HUC) Water Resource regions in order to assist USACE staff in meeting climate change adaptation policies set by the Assistant Secretary of the Army for Civil Works. Each report summarizes observed and projected climate and hydrological patterns cited in peer-reviewed literature and characterizes climate threats to USACE business lines. The LWL and C-51 watershed are located in the South Atlantic-Gulf Region.

With respect to observed data, the IWR report for the South Atlantic-Gulf Region finds a mild ascending trend in temperature and a mild descending trend in streamflow, mainly since the 1970s. However, clear agreement does not exist for either variable among the literature. Studies on precipitation indicate diverse results but, with more research exhibiting increasing annual and seasonal precipitation rather than decreasing, over the past 50 to 100 years.

frequency of extreme storm events will increase in the future for the South Atlantic-Gulf Region, which may lead to increased runoff. However, there is little agreement on the future trends for streamflow and annual/seasonal precipitation. A significant increase in temperature (4°F – 8°F) is predicted for the region by the end of the century. Potential impacts to USACE business lines are illustrated in Figure 1.

CLIMATE VARIABLE	VULNERABILITY
 Increased Ambient Temperatures	<p>Increased ambient air temperatures throughout the century, and over the next century are expected to create the following vulnerabilities on the business lines in the region:</p> <ul style="list-style-type: none"> Loss of vegetation from increased periods of drought and reduced streamflows may have impacts on vegetation within the region, which is important for sediment stabilization in the watershed. Loss of non-drought resistant vegetation may result in an increase in sediment loading, potentially causing geomorphic changes in the tributaries to the river system. Decrease in flows may result from periods of drought and reduced streamflow has implications for maintain water levels in the rivers. Risk of wildfires during hot and dry conditions may cause an increased risk of wildfires, especially in heavily forested and dry areas. Flora and fauna that are not drought resistant can also be impacted by longer drought conditions, which may reduce opportunities for recreational wildlife viewing. <p>BUSINESS LINES IMPACTED:      </p>
 Increased Maximum Temperatures	<p>Air temperatures are expected to increase 2-4°C in the latter half of the 21st century, especially in the summer months. This is expected to create the following vulnerabilities on business lines in the region:</p> <ul style="list-style-type: none"> Increased water temperatures leading to water quality concerns, particularly for the dissolved oxygen (DO) levels, growth of nuisance algal blooms and influence wildlife and supporting food supplies. Increased evapotranspiration. Human health risk increases from extended heat waves, impacting recreational visitors and increasing the need for emergency management. <p>BUSINESS LINES IMPACTED:    </p>
 Increased Storm Intensity and Frequency	<p>Extreme storm events may become more intense and frequent over the coming century which are expected to influence the following vulnerabilities on business lines in the region:</p> <ul style="list-style-type: none"> Increased flows and runoff, which may carry pollutants to receiving water bodies, decreasing water quality. Increased erosion with subsequent changes in sediment accumulation rates and creating water quality concerns. Increased groundwater recharge rates, as residence times are shortened within areas where evapotranspiration takes place during high intensity events. Increased flooding, which may have negative consequences for all infrastructure, habitats, and people in the area. <p>BUSINESS LINES IMPACTED:       </p>
 Sea Level Rise	<p>Sea level rise may exacerbate saltwater intrusion into fresh water supplies.</p> <p>BUSINESS LINES IMPACTED: </p>

NOTE: The Regulatory and Military Program business lines may be impacted by all climate variables








 = Navigation  = Flood Risk Management  = Ecosystem Restoration  = Hydropower  = Recreation  = Water Supply  = Emergency Management

Figure 1: Summary of projected climate trends and impacts on USACE business lines (White, 2015)

1.4 Nonstationarity Detection Tool

The nonstationarity detection tool was not utilized for the LWL project due to the lack of a flow gage located within the watershed. At the time of writing this report, USACE Jacksonville District was in the process of providing gage data to be uploaded to the Nonstationarity Tool database.

1.5 Observed Trends

A qualitative analysis was conducted using data from the S-155 flow gage and two methods from the Climate Hydrology Assessment Tool. This tool allows users to access both existing and projected climate data to support consistent analyses and to potentially develop reliable climate change projections for USACE projects. The first qualitative method involves performing a linear regression of the annual maximum daily discharge and is shown as Figure 2. The second method is similar to the first, however it uses the largest 3-day annual maximum discharge and is shown as Figure 12. Note that in both Figures 11 and 12, the p-value is equal to 0.09 and 0.10, respectively. In both cases, although the slope is negative, the p-value is greater than 0.05 which indicates the data does not exhibit a statistically significant slope and no trends are apparent.

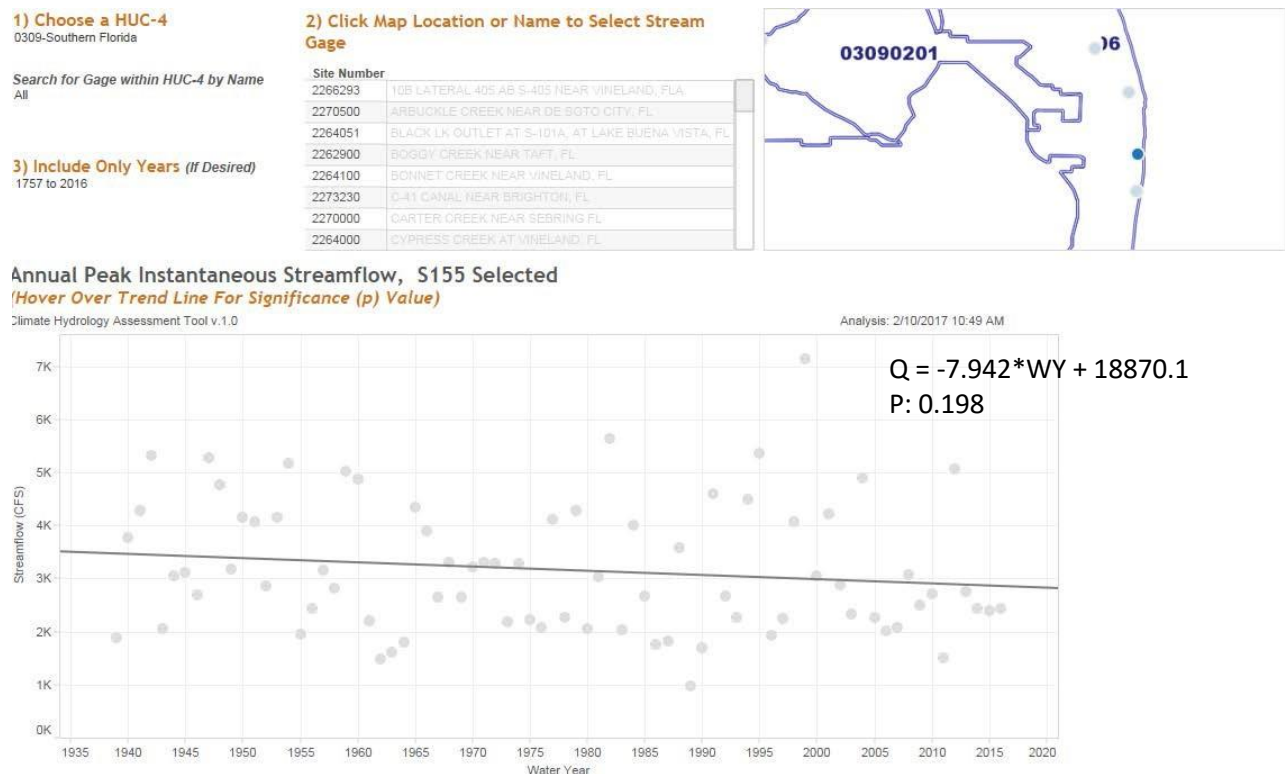


Figure 2: S-155 Annual Maximum Daily Discharge

1.6 Projected Future

Figure 3 displays the range of forecast annual maximum monthly flows and the mean flow computed by 93 different hydrologic climate models for a period of 2000 – 2099 for the HUC-4 Basin 0309 – Southern Florida. These forecast flows display trends consistent with that of observed data as well as available literature. No substantial trend is visible within the projected flows.

An additional analysis was performed to provide first-order detection of any changes in floods for both the observed record and the projected future based on bias-corrected and spatially downscaled data from simulations developed for the Coupled Model Intercomparison Project Phase 5 (CMIP5) data, with hydrologic response simulated by the Variable Infiltration Capacity (VIC) model (Liang et al. 1994).

The first-order statistical analysis for the simulations for 1950 to 1999 indicates a statistically significant decreasing linear trend for potential realizations of runoff for the 20th century (Figure 14). A statistical analysis of the projected hydrology for 2000 to 2099 indicates a statistically significant linear trend of increasing average annual maximum monthly flows (Figure 4). These trends are consistent with the literature for both observed and projected discharge, respectively.

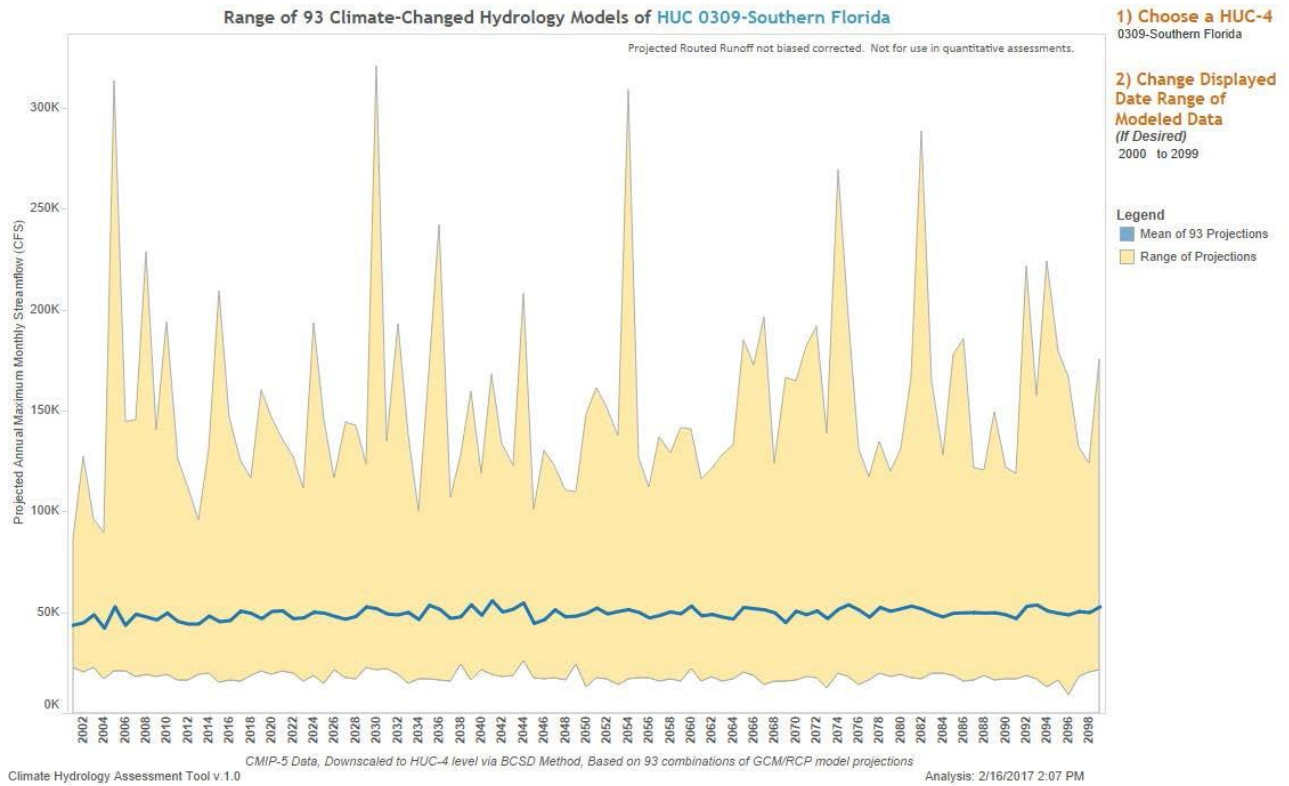


Figure 3: Projected Annual Maximum Monthly Flow - HUC-4 0309 (Based on 93 combinations of Climate Change Model Projections)

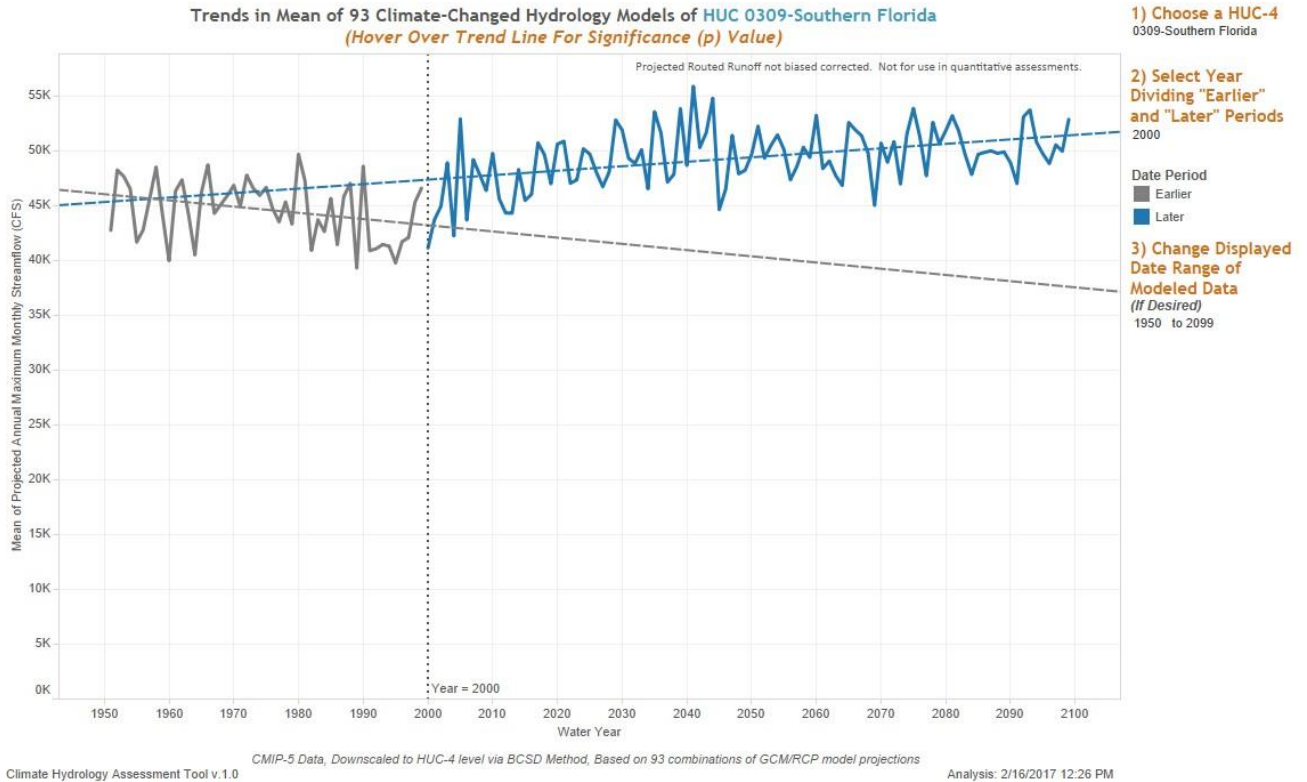


Figure 4: Trends in Historical & Projected Mean Annual Maximum Monthly Flow - HUC-4 0309

1.7 Summary

The observed trend from the annual maximum daily discharge indicates a slight decrease in runoff for the period of record at the S-155 gage; however, the literature presents some uncertainty in the runoff trends in the watershed. These trends will be dependent on changes in land use, which may be linked to the rate of sea level rise as former agricultural lands become developed due to coastal residents moving inland. Additionally, a change in the operations of the C-51 canal, S-155 spillway structure, or other major structures upstream could alter the natural variations (frequency and magnitude) of flow from storm event runoff, possibly skewing the data. The analysis of projected future conditions indicates that climate change in the next 50 years may increase flood flow frequency in the study basin. Based on the assessment, which shows differing but relatively small signals, the recommendation is to treat the potential increases in flood magnitude as occurring within the uncertainty range calculated for the current hydrologic analysis.

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**US Army Corps of
Engineers®**

Palm Beach County, Lake Worth Lagoon, Florida

CAP Section 1135 – Restoration Project

Project Cost Abbreviated Risk Analysis Report

Prepared by:

**U.S. Army Corps of Engineers
Jacksonville District**

December 2017

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Appendix A – Cost Certification 10

EXECUTIVE SUMMARY

This Project Cost and Abbreviated Risk Analysis (ARA) Report has been completed by the US Army Corps of Engineers (USACE), Jacksonville District. The ARA was developed with tools provided by the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works. The ARA was reviewed internally by Jacksonville District Cost Engineering before being presented for Agency Technical Review (ATR). This report presents a recommendation for the total project cost contingency for cost certification of the Lake Worth Lagoon Ecosystem Restoration Project. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, an abbreviated risk analysis study was conducted for the development of the contingency to be applied to the total project cost. The purpose of this risk analysis was to establish a project contingency by identifying and measuring the cost impact of project uncertainties with respect to the estimated total project cost.

Specific to Lake Worth Lagoon, the most likely total project cost (at project first cost) is at approximately \$11,973K. Based on the results of the analysis, the Jacksonville District recommends a contingency value of approximately \$1,939K or 23.3% for construction costs; \$92K or 13.2% for Planning, Engineering, and Design costs; and \$110K or 17.4% for Construction Management costs for a combine contingency of 21.9%. An ARA was developed to model the remaining work concerning scope growth, potential for mods and claims, and other concerns as seen in the risk register.

The Jacksonville District Cost Engineering Section performed the risk analysis for this project and it has been internally reviewed, as required, via the ATR process.

MAIN REPORT

1.0 PURPOSE

This report presents a recommendation for the total project cost contingencies for the cost certification of Lake Worth Lagoon Project.

2.0 BACKGROUND

This estimate is primarily based upon the October 2016 Engineering Appendix, for Lake Worth Lagoon Ecosystem Restoration Project located in West Palm Beach, Florida.

The study area is located within Lake Worth Lagoon in Palm Beach County, Florida. Lake Worth Lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Palm Beach Island and Singer Island. It is approximately 20 miles long and up to one mile wide. Refer to the main report for more information.

Lake Worth Lagoon has encountered losses in seagrass, mangrove, and oyster habitat due to several Federal projects, altered hydrology, and large-scale freshwater discharges into Lake Worth Lagoon.

During the feasibility study the project delivery team (PDT) evaluated another four alternatives to attempt solve some of the problems from different avenues of approach. After a delivered evaluation discussed on the Engineer Appendix the alternative were screen out leaving alternative 1B as the tentative selected plan. Refer to the Engineer Appendix for more information about the other screened out alternatives.

A. Previous alternative overview:

1. Alternative 1A – The objective of this alternative is to place material exported from Peanut Island 6.0 miles away from the "El Cid" location. The material will be used to create the habitat for mangrove along with oyster reef environment and possible seagrass. The end state for this alternative is to create couple Islands for mangrove that will be protected with Rip Raps and oyster reef around the islands.
2. Alternative 1B – The objective of this alternative is to place material exported from Peanut Island 11.8 miles away from the "Bonefish" location. The material will be used to create the habitat for mangrove along with oyster reef environment and possible seagrass. The end state for this alternative is to create couple Islands for mangrove that will be protected with Rip Raps and oyster reef around the islands.
3. Alternative 2A – The objective of this alternative is to cap the muck with sand material exported from Peanut Island 6.0 miles away from the "El Cid" location. The difference from this alternative of ALT 1A is the replacement of mangrove Islands with Goliath Reef Balls (6ft x 6ft). The ends state of this alternative is cap in place the muck and create oyster reef habitat.

4. Alternative 2B – The objective of this alternative is to cap the muck with sand material exported from Peanut Island 11.8 miles away from the "Bonefish" location. The difference from this alternative of ALT 1B is the replacement of mangrove Islands with Goliath Reef Balls (6ft x 6ft). The ends state of this alternative is cap in place the muck and create oyster reef habitat.

Table 1: Alternative Cost Comparison (First Cost)

Alternative	Rough Order of Magnitude - 15 September 2016	Updated Cost Estimate - 28 October 2016	Refined Construction Cost – 02 February 2017
Alternative 1A - El CID	\$5,900,000	\$7,600,000 *[\$9,100,000]	
Alternative 1B - Bonefish	\$10,500,000	11,700,000 *[\$13,500,000]	\$10,359 *[\$11,973,000]
Alternative 2A - El CID	\$6,200,000		
Alternative 2B - Bonefish	\$11,200,000		
*Values in brackets represent the Construction and Non-construction Cost.			
Notes:			
1. Values without "*" are construction cost only.			
2. The values include contingency			

The estimate is based on Alternative 1B; using 345,000 cubic yards (cy) of fill material from Peanut Island to create habitat areas for Mangrove tress, and 11.2 acres of oyster habitat within the Bonefish Cove area. The project is under the Continuing Authorities Program Section 1135 with the intent to create a sustainable habitat for marine ecosystem flora and fauna within Lake Worth Lagoon.

3.0 REPORT SCOPE

The scope of this report is to facilitate a technical overview of the tentative selected plan. Part of the report include the risk analysis report used to calculate and present the cost contingency at the 80% confidence level using the risk analysis processes, as mandated by U.S Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The recommended plan is to place material exported from Peanut Island 11.8 miles away from the "Bonefish" location. The material will be used to create the habitat for mangrove along with oyster reef environment and possible seagrass. The end state for this alternative is to create couple Islands for mangrove that will be protected with Rip Rap and pre-fabricated reef modules around the Islands.

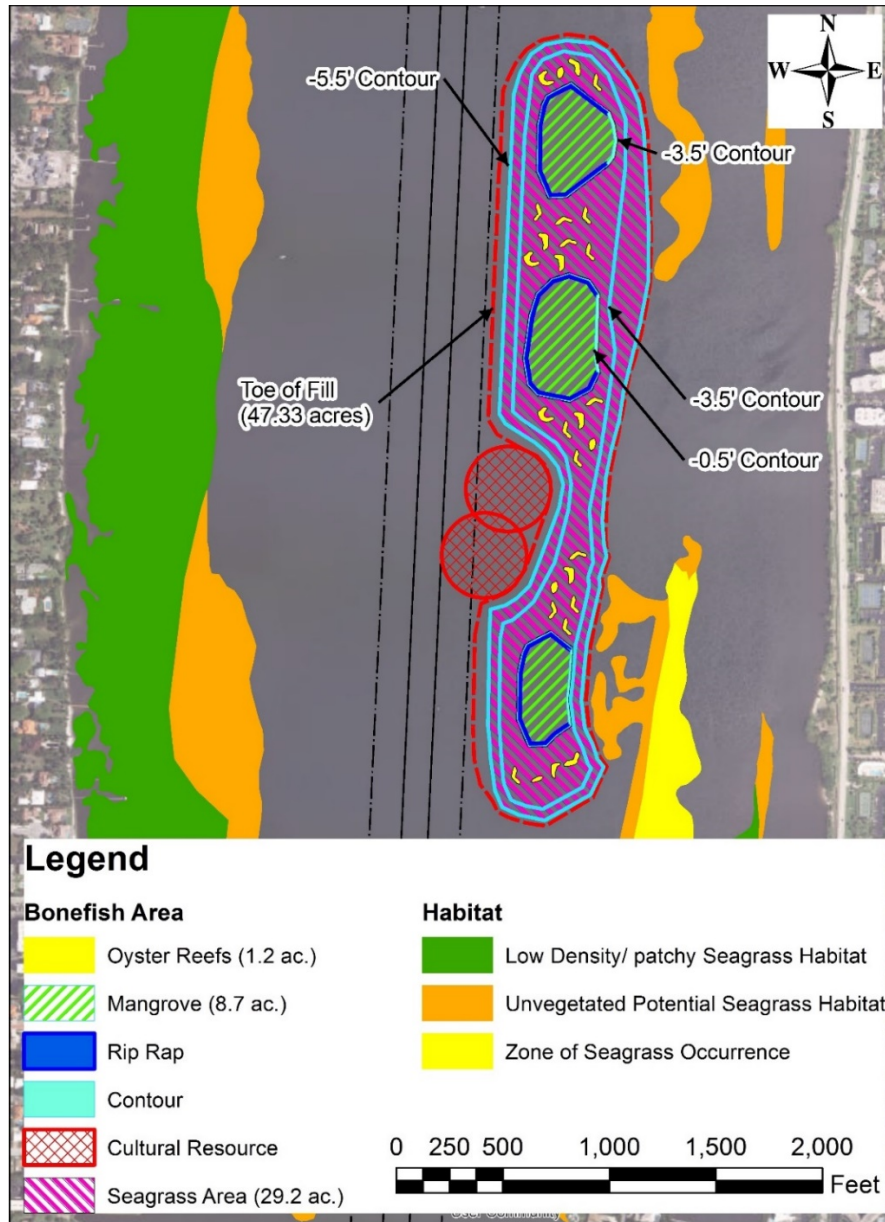


Figure 1: Bonefish Conceptual Plan – Top view

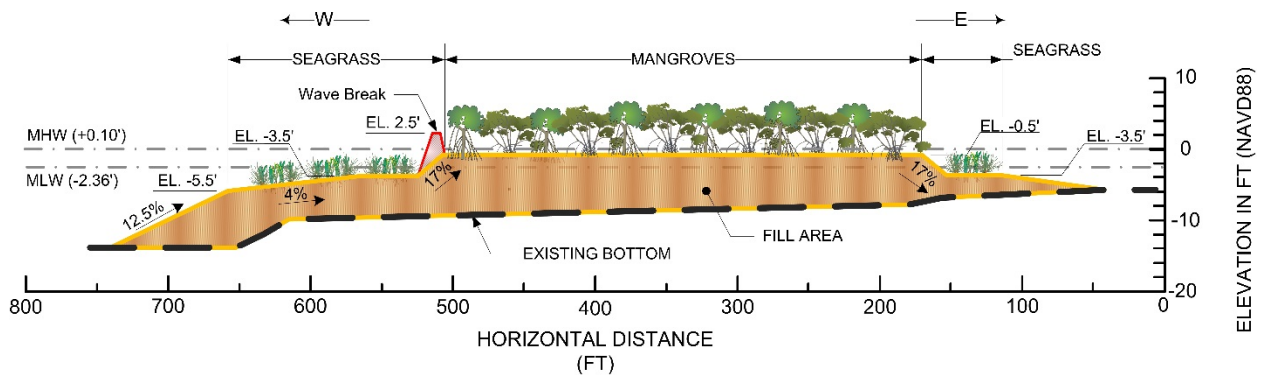


Figure 2: Bonefish Conceptual Plan – Cross section

A. Project Assumption used for the cost estimate:

1. Contractor will maintain a continue water quality monitoring during the construction and will maintain the turbidity barrier.
2. The contractor will has to provide daily water transportation from the Port of Palm Beach to Peanut Island and to Bonefish.
3. The project site and the borrow area has limited access by water only. The logistic of the project is complex because heavily depend on water transportation for the construction equipment, material and personnel. The equipment maintenance also need to be conducted by water along with the re-fueling operations.
4. The project will have an adaptive management plan for seagrass and mangrove. The assumption is the adaptive management could be extended up to five years.
5. Peanut Island has internal roads that will facilitate the use of highway truck to haul the material from the extraction point to the shore.
6. The construction method is based on the previous project conducted in Lake Worth Lagoon area.
 - a) The material will be excavated from Peanut Island and transported to the shore and loaded in a barge with a conveyor. Equipment use at the island will be Heavy Equipment only.
 - b) The loaded material will be transported in from Peanut Island to the final destination. Equipment and crew cost were extracted from CEDEP along with the mobilization and demobilization.
 - c) The material will unloaded at “Bonefish” area with an excavator in a flat barge. The excavator will load the pump to the final delivery.
 - d) Refer to figure 2, 3, 4, and 5 for an example of the construction method used for the cost estimate.
7. Any deviations from these assumptions will impact costs. The magnitude of those impacts will vary.

Figure 3: Peanut Island



This is from where the material will be extracted for the creation on “Bonefish”.



Figure 4: Peanut Island during Snook Island Project

This photo represents how the material will be transported from Peanut Island to “Bonefish”.



Figure 5: Material Placement

The photo represents the how the material will be loaded from Peanut Island to the barge.



Figure 6: Photo from Snook Island Project

This photo represents how the material was transported to the final destination at "Snook Island"

- B. Major Project Features includes:
 - 1. Three island for mangrove habitat.
 - 2. Wave break.
 - 3. Seagrass habitat.

- C. Construction Sequence:
 - 4. Establish operation in Peanut Island.
 - 5. Excavate the material and stock pile at the shore.
 - 6. Simultaneously initiate hauling the material to Bonefish and offload the material.
 - 7. Once the material is above the water level on the three island use heavy equipment to build the wave break and grade the islands.
 - 8. Close operations at Peanut Island.
 - 9. The estimated construction duration is 390 calendar days.

4.0 ABBREVIATED RISK ANALYSIS METHODOLOGY/PROCESS

The risk analysis process for this estimate is intended to determine the probability of various cost outcomes and to quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

Contingency for the cost estimate has been developed using materials provided by the USACE Cost Center of Expertise located in Walla Walla District. The cost estimator assigned risk factors based upon the project Work Breakdown Structure. The contingency was developed using an abbreviated format since the total project cost is below the threshold for completing a formal Cost and Schedule Risk Analysis. The contingency was primarily affected by the weight of mostly likely and possible risks with regards to utilities, ramps, and levee work. Their impacts ranged from marginal to significant.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Appendix.

4.1 Identify and Assess Risk Factors

Identifying risk factors is considered a qualitative process that results in establishing a risk register that serves as the basis for the resulting contingency percentage. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule. A risk brainstorming session was conducted November 08, 2016, to discuss all possible risks and impacts. The Project Delivery Team (PDT) attendees are listed on the PDT Involvement tab of the ARA spreadsheet.

Contingency is analyzed using formulas within the spreadsheet, as opposed to the more complex

analysis of the Crystal Ball software's *Monte Carlo* simulations used in a formal cost and schedule risk analysis. Contingencies are calculated according to the likelihood and impact of each factor identified in the risk register.

The Abbreviate Risk Analysis was developed with input of the Project delivery team (PDT) and with the sponsor. The highest risk level identified during the development of the Risk Register was level 3. This risk was associated with the potential increment in cost due the possibility to change the material design to build the oyster reef habitat. The concern is expected to be address during the planning and implementation phase of the project. The rest of the concern risk levels are level 2 and under.

A. Some of the concerns registered in the Risk Register are:

1. Possible construction schedule delays due to season restrictions and possible environmental constraints. This concerns have been addressed on the Risk Register.
2. Dependency on Port of Palm Beach for water access. This concern has been addressed on the Risk Register.
3. Possible delays on the water transportation due to the pass through bridges and adverse weather conditions. This concern has been addressed on the Risk Register.

This tool helped the development of the contingency for the project and provide essential information that could be used to establishment of control measures. The Risk Register will continue be updated during the project live cycle.

5.0 KEY ASSUMPTIONS AND LIMITATIONS

Key assumptions and limitations are those that are most likely to significantly affect the determinations of contingency presented in the CSRA. The key assumptions and limitations are important to help ensure that project leadership and other decision makers understand the steps, logic, and decisions made in the risk analysis, as well as any resultant implications on the use of outcomes and results.

A. Key assumptions:

1. Estimate assumes a Dredging Contractor as the Prime.
2. Construction will be executed during day light hours and only five days a week.
3. Contractor will maintain a continue water quality monitoring during the construction and will maintain the turbidity barrier.
4. The project site and the borrow area have limited access by water only.
5. Peanut Island will provide all the material need to build bonefish.
6. Rip rap will be obtained from commercial resources.

6.0 RESULTS

6.1 Risk Register

An abbreviated risk register, provided in Appendix A, is a tool commonly used in project planning and risk analysis. It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on

large projects with extended schedules.

Specific to this abbreviated risk register, it should be noted that there are events reported in the register, but not included in the calculations. That is, the risk register shows the risk events, but they do not contribute to the contingency calculations. In a formal risk analysis, such a practice is commonly used on risks/opportunity events with a Low Risk Level (typical for cost and schedule events with some combination of, for example, Very Unlikely/Unlikely Likelihoods and Negligible/Marginal Impacts). These are documented, but excluded from the calculations in order to better prevent skewed results. Under Risk Level, these show with a Zero (0).

As mentioned in the Executive Summary, tools/materials from the MCX were used throughout the process of acknowledging this risk, trying to account for it, running into the calculation issue, and coming up with the resolution.

6.2 Cost Contingency

The contingency was calculated based off the likelihood and impact of the risk concerns. Some of the major areas of concern were seen under the Construction Elements and External Project Risks categories. For example, the risks for Utilities could have a significant impact on the cost, as there has been a history of issues pertaining to Utilities for this project area.

Table 1 provides the raw contingencies percentages calculated based upon the factors assigned in the risk register.

Table 2: Project Cost Contingency Summary

Totals	% Contingency
Real Estate	15.0 %
Adaptive Management	7.1 %
Construction	23.3 %
Planning, Engineering & Design	13.2 %
Construction Management	17.4 %
Combine Contingency	21.9 %

APPENDIX A – COST CERTIFICATION

**WALLA WALLA COST ENGINEERING
MANDATORY CENTER OF EXPERTISE**

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 447752

**SAJ – Lake Worth Lagoon Section 1135
Ecosystem Restoration Project**

The Lake Worth Lagoon Section 1135 project as presented by Jacksonville District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of November 16, 2017, the Cost MCX certifies the estimated total project cost:

FY 18 Project First Cost:	\$11,973,000
Total Project Cost:	\$12,358,000
Estimated Federal Cost:	\$9,776,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal participation.



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2017.11.16 11:07:55 -08'00'

Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

PROJECT: **Lake Worth Lagoon (CAP 1135)**
PROJECT NO **447752**
LOCATION: **West Palm Beach, Florida**

DISTRICT: **Jacksonville District**

PREPARED: **14/11/2017**

POC: **CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM**

This Estimate reflects the scope and schedule in report; CAP Feasibility study dated December 2016

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)					TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST (\$K)	CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	REMAINING COST (\$K)	2018 1-Oct-17 Spent Thru: 9/30/2017 (\$K)	TOTAL FIRST COST (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	FULL (\$K)
06	ADAPTIVE MANAGEMENT	\$145	\$10	7.1%	\$155	1.8%	\$148	\$10	\$158		\$158	13.1%	\$167	\$12	\$179
CONSTRUCTION ESTIMATE TOTALS:		\$8,267	\$1,904		\$10,171	1.8%	\$8,420	\$1,939	\$10,359		\$10,359	3.1%	\$8,683	\$1,998	\$10,681
01	LANDS AND DAMAGES	\$72	\$11	15.0%	\$83	1.8%	\$73	\$11	\$84		\$84	0.5%	\$74	\$11	\$85
30	PLANNING, ENGINEERING & DESIGN	\$672	\$89	13.2%	\$761	3.6%	\$696	\$92	\$788		\$788	2.4%	\$713	\$94	\$808
31	CONSTRUCTION MANAGEMENT	\$609	\$106	17.4%	\$715	3.6%	\$631	\$110	\$741		\$741	5.9%	\$668	\$116	\$785
PROJECT COST TOTALS:		\$9,620	\$2,110	21.9%	\$11,730		\$9,820	\$2,152	\$11,973		\$11,973	3.2%	\$10,138	\$2,219	\$12,358

- _____ CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM
- _____ PROJECT MANAGER, JAMES SUGGS
- _____ CHIEF, REAL ESTATE, AUDREY ORMEROD
- _____ CHIEF, PLANNING, ERIC SUMMA
- _____ CHIEF, ENGINEERING, LAUREEN BOROCHANER
- _____ CHIEF, OPERATIONS, CANDIDA BRONSON
- _____ CHIEF, CONSTRUCTION, STEPHEN DUBA
- _____ CHIEF, CONTRACTING, TIMOTHY BLACK
- _____ CHIEF, PM-PB, KAREN SMITH
- _____ CHIEF, DPM, TIM MURPHY

ESTIMATED TOTAL PROJECT COST:		\$12,358
ESTIMATED FEDERAL COST:	75%	\$9,268
ESTIMATED NON-FEDERAL COST:	25%	\$3,089
22 - FEASIBILITY STUDY (CAP studies):		\$916
ESTIMATED FEDERAL COST:		\$508
ESTIMATED NON-FEDERAL COST:		\$408
ESTIMATED FEDERAL COST OF PROJECT		\$9,776

**WALLA WALLA COST ENGINEERING
MANDATORY CENTER OF EXPERTISE**

COST AGENCY TECHNICAL REVIEW

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Chief, Cost Engineering MCX
Walla Walla District**

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PROJECT NO **447752**
LOCATION: **West Palm Beach, Florida**

DISTRICT: **Jacksonville District**

PREPARED: **14/11/2017**

POC: **CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM**

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30	PLANNING, ENGINEERING & DESIGN	\$672	\$89	13.2%	\$761	3.6%	\$696	\$92	\$788		\$788	2.4%	\$713	\$94	\$808
31	CONSTRUCTION MANAGEMENT	\$609	\$106	17.4%	\$715	3.6%	\$631	\$110	\$741		\$741	5.9%	\$668	\$116	\$785
PROJECT COST TOTALS:		\$9,620	\$2,110	21.9%	\$11,730		\$9,820	\$2,152	\$11,973		\$11,973	3.2%	\$10,138	\$2,219	\$12,358

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ESTIMATED NON-FEDERAL COST:	25%	\$3,089
22 - FEASIBILITY STUDY (CAP studies):		\$916
ESTIMATED FEDERAL COST:		\$508
ESTIMATED NON-FEDERAL COST:		\$408
ESTIMATED FEDERAL COST OF PROJECT		\$9,776

**** CONTRACT COST SUMMARY ****

PROJECT: Lake Worth Lagoon (CAP 1135)
LOCATION: West Palm Beach, Florida
This Estimate reflects the scope and schedule in report;

CAP Feasibility study dated December 2016

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM

PREPARED: 14/11/2017

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 14/11/2017		Estimate Price Level: 10/1/2017		Program Year (Budget EC): 2018		Effective Price Level Date: 1-Oct-17						
		RISK BASED												
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST (\$K)	CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	TOTAL (\$K)	Mid-Point Date	ESC (%)	COST (\$K)	CNTG (\$K)	FULL (\$K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
PHASE 1 or CONTRACT 1														
09	CHANNELS & CANALS	\$694	\$64	9.3%	\$759	1.8%	\$707	\$66	\$773	2019Q3	2.9%	\$728	\$68	\$795
09	CHANNEL - BANK STABILIZE	\$7,337	\$1,806	24.6%	\$9,143	1.8%	\$7,473	\$1,839	\$9,312	2019Q3	2.9%	\$7,693	\$1,893	\$9,586
09	CHANNEL - ASSOCIATED GEN. ITEMS	\$91	\$24	26.3%	\$115	1.8%	\$93	\$24	\$117	2019Q3	2.9%	\$95	\$25	\$121
06	ADAPTIVE MANAGEMENT	\$145	\$10	7.1%	\$155	1.8%	\$148	\$10	\$158	2024Q2	13.1%	\$167	\$12	\$179
CONSTRUCTION ESTIMATE TOTALS:		\$8,267	\$1,904	23.0%	\$10,171		\$8,420	\$1,939	\$10,359			\$8,683	\$1,998	\$10,681
01	LANDS AND DAMAGES	\$72	\$11	15.0%	\$83	1.8%	\$73	\$11	\$84	2018Q2	0.5%	\$74	\$11	\$85
30	PLANNING, ENGINEERING & DESIGN													
0.8%	Project Management	\$61	\$8	13.2%	\$69	3.6%	\$63	\$8	\$72	2018Q2	0.9%	\$64	\$8	\$72
0.5%	Planning & Environmental Compliance	\$41	\$5	13.2%	\$46	3.6%	\$42	\$6	\$48	2018Q2	0.9%	\$43	\$6	\$49
3.0%	Engineering & Design	\$244	\$32	13.2%	\$276	3.6%	\$253	\$33	\$286	2018Q2	0.9%	\$255	\$34	\$289
0.5%	Engineering Tech Review ITR & VE	\$41	\$5	13.2%	\$46	3.6%	\$42	\$6	\$48	2018Q2	0.9%	\$43	\$6	\$49
0.5%	Contracting & Reprographics	\$41	\$5	13.2%	\$46	3.6%	\$42	\$6	\$48	2018Q2	0.9%	\$43	\$6	\$49
1.5%	Engineering During Construction	\$122	\$16	13.2%	\$138	3.6%	\$126	\$17	\$143	2019Q3	5.9%	\$134	\$18	\$152
1.0%	Planning During Construction	\$81	\$11	13.2%	\$92	3.6%	\$84	\$11	\$95	2019Q3	5.9%	\$89	\$12	\$101
0.5%	Project Operations	\$41	\$5	13.2%	\$46	3.6%	\$42	\$6	\$48	2018Q2	0.9%	\$43	\$6	\$49
31	CONSTRUCTION MANAGEMENT													
6.0%	Construction Management	\$487	\$85	17.4%	\$572	3.6%	\$505	\$88	\$592	2019Q3	5.9%	\$534	\$93	\$627
0.8%	Project Operation:	\$61	\$11	17.4%	\$72	3.6%	\$63	\$11	\$74	2019Q3	5.9%	\$67	\$12	\$79
0.8%	Project Management	\$61	\$11	17.4%	\$72	3.6%	\$63	\$11	\$74	2019Q3	5.9%	\$67	\$12	\$79
CONTRACT COST TOTALS:		\$9,620	\$2,110		\$11,730		\$9,820	\$2,152	\$11,973			\$10,138	\$2,219	\$12,358

APPENDIX C

REAL ESTATE APPENDIX

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017
Revised January 2018



**US Army Corps
of Engineers**®
Jacksonville District

DRAFT

APPENDIX C

**LAKE WORTH LAGOON
CONTINUING AUTHORITY PROGRAM (CAP)
SEC 1135 PROJECT MODIFICATION
PALM BEACH COUNTY, FLORIDA**

**INTEGRATED FEASIBILITY REPORT AND
ENVIRONMENTAL ASSESSMENT**

REAL ESTATE PLAN

DRAFT

**LAKE WORTH LAGOON
CONTINUING AUTHORITY PROGRAM (CAP)
SEC 1135 PROJECT MODIFICATION
PALM BEACH COUNTY, FLORIDA**

**INTEGRATED FEASIBILITY REPORT AND
ENVIRONMENTAL ASSESSMENT
REAL ESTATE PLAN**

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DRAFT

APPENDIX C

**LAKE WORTH LAGOON
CONTINUING AUTHORITY PROGRAM (CAP)
SEC 1135 PROJECT MODIFICATION
PALM BEACH COUNTY, FLORIDA**

**INTEGRATED FEASIBILITY REPORT AND
ENVIRONMENTAL ASSESSMENT**

REAL ESTATE PLAN

1. STATEMENT OF PURPOSE.

This Real Estate Plan (REP) is provided in support of Palm Beach County the Non-Federal sponsor and the Lake Worth Lagoon Feasibility Study. The purpose of the study is to recommend the methods and plans for solutions to reduce the salinity levels for Lake Worth Lagoon Restoration project for Palm Beach County, Florida. The purpose of the modification is to restore seagrass, mangroves, and oyster habitats within the Lake Worth Estuary. The resources were lost due to dredging and filling activities associated with the Intercostal Waterway Jacksonville to Miami (IWW J-M) and Palm Beach Harbor Navigation Project (PBHNP). This real estate appendix will include an evaluated alternative, costs and benefits, and recommendations. Upon approval, this document will be included as an appendix to the Final Integrated Feasibility Report.

This report is preliminary and is intended for planning purposes only. Both the final real property lines and land value estimates are subject to change even after approval of this report. There may be modifications to the plans that occur during Pre-construction, Engineering and Design (PED) phase, thus changing the final acquisition area(s) and/or administrative and land costs.

2. PROJECT AND STUDY AUTHORIZATION.

This study was authorized under Continuing Authority Program (CAP) Section 1135 of the Water Resources Development Act (WRDA) of 1986 (33 USC 2309a), "Project modifications for the improvement of the environment", as amended. This authority provides for the review and modification of water resources projects built by the United States Army Corps of Engineers (USACE) for the purpose of improving environmental quality. In addition, if it is determined that a USACE water resources project has contributed to environmental degradation, restoration measures may be implemented if these measures do not conflict with the authorized project purposes.

3. PROJECT LOCATION

The study area is located within Lake Worth Lagoon in Palm Beach County, Florida. Lake Worth Lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Palm Beach Island and Singer Island. It is approximately 20 miles long and up to one mile wide. The Lake Worth Inlet connects the northern part of the lagoon to the ocean and is the entrance channel to the Port of Palm Beach. South Lake Worth inlet connects the southern part of the lagoon to the ocean and is primarily used by recreational boaters. The project is located approximately three miles north of South Lake Worth Inlet as indicated by the green arrow in Figure 1.



Figure 1

4. PROJECT DESCRIPTION

The purpose of the construction project is to create a habitat for mangroves, seagrass, and an oyster reef environment protected by riprap as indicated in Figure 2. The construction will require approximately 345,000 cubic yards of material taken from the Peanut Island Dredge Disposal Management Area.

5. REAL ESTATE REQUIREMENTS.

The construction activities as proposed are within the navigable waters of the United States and available to the Federal Government by navigation servitude. The borrow area identified for the project is located on Peanut Island and is approximately 18 miles north of the project area. The borrow area will be available via a borrow easement from the non-federal sponsor. Access to the borrow area will take place from the water's edge to the borrow area via a road easement from the non-federal sponsor. A staging area will be available via a temporary work easement from the non-federal sponsor. Refer to Peanut Island map.

6. ESTATE TO BE ACQUIRED.

a) Borrow Easement:

A Perpetual and assignable right and easement to clear, borrow, excavate and remove soil, dirt and other materials from (land described in Schedule A) (Tract Nos _____, _____ and _____); subject, however, to existing easement for public roads and highway, public utilities, railroads and pipelines: reserving, however, to the landowner, their heirs and assigns, all such rights and privileges in said land as may be used without interfering with or abridging the rights and easements hereby acquired.

b) Road Easement:

A (perpetual non-exclusive and assignable) (temporary) easement and right-of-way in, on over and across (the land described in Schedule A) (Tracts Nos, _____, _____ and _____) for the location, construction, operation, maintenance, alteration replacement of (a) road (s) and appurtenances therein; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of way as access to their adjoining land at the locations indicated in Schedule B;) subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

c) Temporary Work Area Easement

A temporary easement and right-of-way in, on, and over across (the land described in Schedule A) Tracts Nos _____, _____ and _____), for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agent, and contractors as a work area to move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowner, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridge the rights and easements hereby required; subject however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

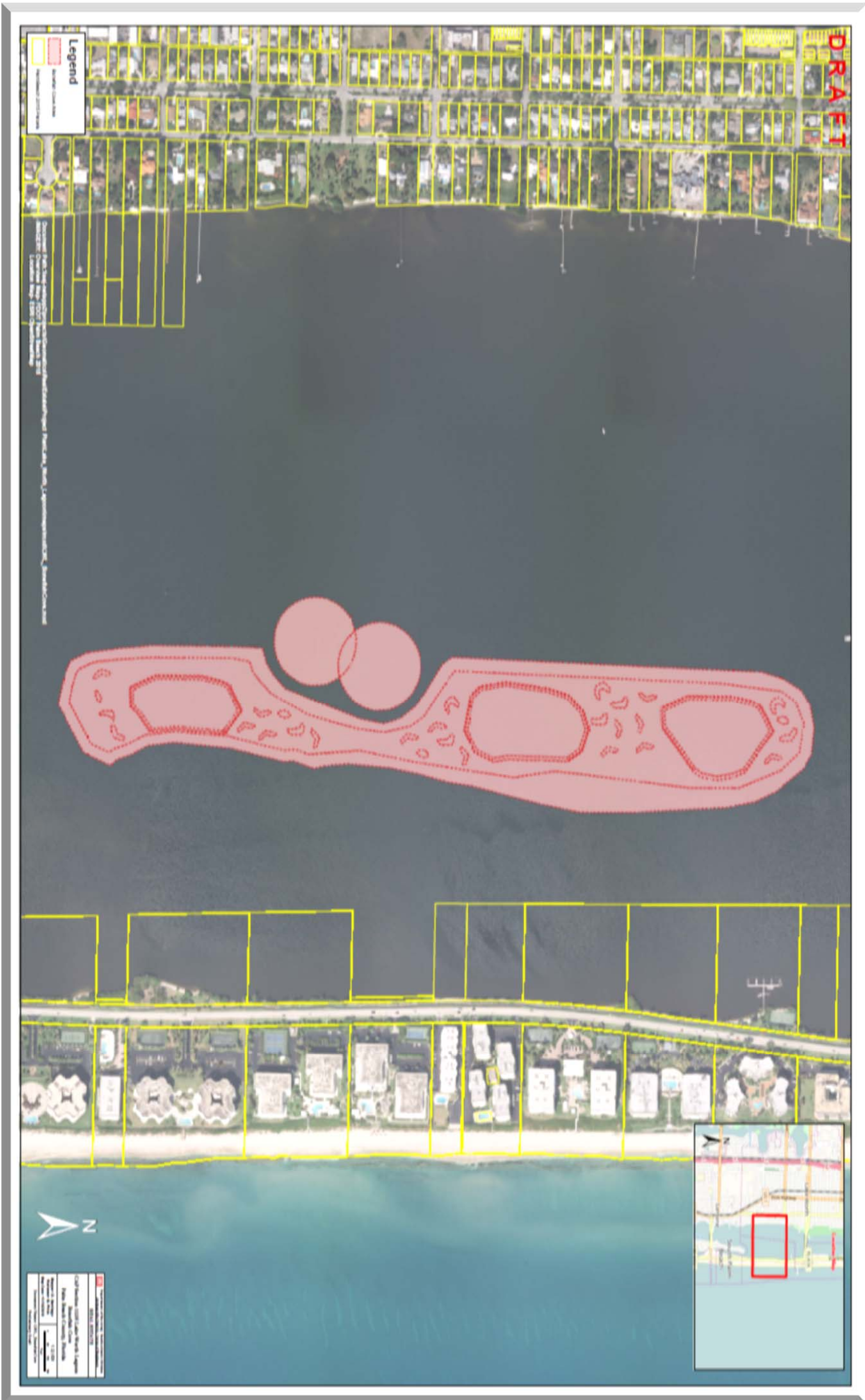


Figure 2: Bonefish Habitat

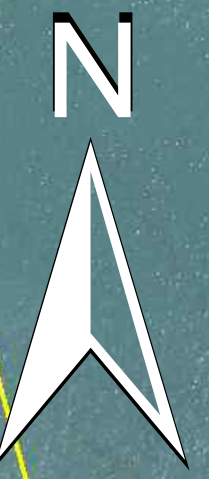
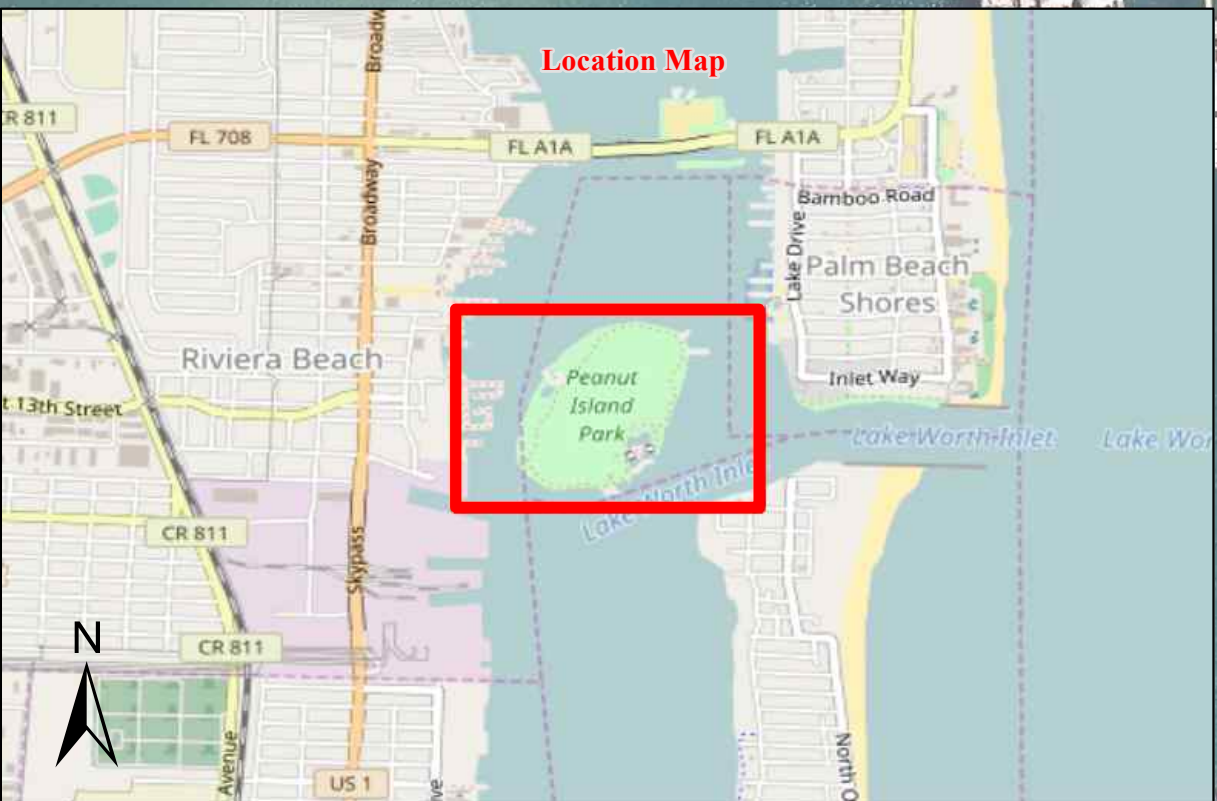


Lake Worth Lagoon

Primary Source
F.I.N.D DMMA

Peanut Island

Secondary Source
Port DMMA



Legend

- Borrow Area
- Transportation Route
- Staging Area
- Barge Offloading Area
- PalmBeach 2015 Parcels

Department of the Army South Atlantic Division
Jacksonville District, Corps of Engineers

REAL ESTATE

**CAP Section 1135 Lake Worth Lagoon
Peanut Island
Disposal Material Management Area
Palm Beach County, Florida**

Mapper: D. Santiago	1:1,404
Reviewer: B. Price	0 80 160 240
Map Date: 1/5/2017	Feet

Document Name: LWL_PeanutIsland
RE Map

Document Path: P:\RealEstate\Project Plan\Lake_Worth_Lagoon\maps\mxd\LWL_PeanutIsland.mxd

IMAGERY: Overview Map-FDOT Palm Beach 2015
Location Map-ESRI OpenStreetMap

56434233190010010

564342330000451

7. FEDERALLY-OWNED LAND

There are no Federal owned lands within the project limits.

8. NON-FEDERALLY-OWNED LAND

Approximately 40.5 acres of the project lands (borrow area) are owned by the Florida Inland Navigation District.

9. NON-FEDERAL OPERATION AND MAINTENANCE RESPONSIBILITIES

Operation and maintenance is a 100% non-federal responsibility.

10. NON-FEDERAL AUTHORITY TO PARTICIPATE IN PROJECT

Palm Beach County, Florida is a political subdivision of the State of Florida as provided by Article 8, Section 1 of the Florida Constitution.

Counties of Florida are empowered by Florida Statutes 125.01(j) to “Establish and administer programs of housing, slum clearance, community redevelopment, conservation, flood and beach erosion control and erosion control, air pollution control and navigation and drainage and cooperation with government agencies and private enterprises in the development and operation of such programs.”

Palm Beach County as the NFS for the project has been an integral part of the Project Delivery Team (PDT) from the conception of the project. At each step of the process, Palm Beach County has contributed to the available information, participated in the formulation, and review of the report.

11. NAVIGATION SERVITUDE

The project will be constructed within the navigable waters of the United States and available via navigation servitude.

12. ATTITUDE OF OWNERS

The County of Palm Beach the project sponsor, fully supports the project. All indications to date are that the public support the project.

13. MINERALS

There are no present or anticipated mineral activity within the project area that would affect the construction, operation, or maintenance of the project.

14. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

No signs of potential HTRW problems were identified and no sites with potential for contamination with HTRW were found.

15. INDUCED FLOODING

There will be no induced flooding directly associated with this project.

16. ZONING ORDINANCES

Applications or enactment of zoning ordinances will not be used in lieu of acquisition.

17. RELOCATIONS ASSISTANCE (PL 91-646, AS AMENDED)

No persons or businesses will be impacted by this project.

18. RELOCATIONS, ALTERATIONS, VACATIONS, AND ABANDONMENTS

No relocations, alterations, vacations or abandonments of utilities, structures facilities, cemeteries, or towns have been identified within the proposed construction limits of the recommended plan.

19. STANDING TIMBER AND VEGETATIVE COVER

There is no timber or unusual vegetative cover that will be impacted by the project.

20. RECREATION RESOURCES

There are no separable recreational lands identified for this project.

21. CULTURES RESOURCES

There are no known cultural resources that have been identified as being affected by this project.

22. OUTSTANDING RIGHTS

There are no known outstanding rights in the project area.

23. MITIGATION

There is no mitigation for the Recommended Plan.

24. AQUISITION/ADMINISTRATIVE COSTS

The estimate of the Federal real estate administrative cost is **\$ 36,500.00**. This figure includes project real estate planning, mapping, review, oversight, monitoring, analysis of real estate requirements and estates. The non-Federal sponsor will receive credit towards its share of real estate administrative project cost incurred for certifications. Non-Federal acquisition/administrative costs are estimated to be **\$ 36,500.00**.

25. SUMMARY OF PROJECT REAL ESTATE COSTS.

The following cost figures are subject to change prior to construction. The Lands and Damages are zero because they are within navigation servitude.

a. Lands and Damages		\$ 0
b. Acquisition Administrative cost		\$73,000.00
	Federal	\$36,500.00
	Non-Federal	\$36,500.00
c. Public Law 91-646		\$ 0
d. Condemnations		\$ 0
e. Total Estimated Real Estate Cost		\$ 73,000.00
f. Contingency (15%)		\$ 11,000.00
g. Total Real Estate Costs		\$ 84,000.00

CHART OF ACCOUNTS FOR PROJECT

26.

01 - Lands & Damages		\$ 0
01B-- Acquisitions		\$ 73,000.00
01B20 - Non-Federal	\$36,500.00	
01B40 – Federal	\$36,500.00	
01B10 - By Govt	\$ 0	
01B20 - By Local sponsor	\$ 0	

01E10 - By Govt (In-House)	\$ 0	
01M00 – Contingency (15%)		\$11,000.00
Total Estimated Real Estate Cost:		\$ 84,000.00



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
701 SAN MARCO BLVD
JACKSONVILLE, FLORIDA 32207-8175

Real Estate Division

David Carson
Senior Environmental Analyst
Palm Beach County
Department of Environmental Resources Management
West Palm Beach, FL 33401

Dear Mr. Carson:

The intent of this letter is to formally advise the County of Palm Beach, as the Non-Federal sponsor for the Lake Worth Lagoon Continuing Authority Program (CAP) Sec 1135 Project Modification Feasibility Study, of the risks associated with land acquisition prior to the execution of the Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a non-federal sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the non-federal sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include, but may not be limited to, the following:

1. Congress may not appropriate funds to construct the proposed project;
2. The proposed project may otherwise not be funded or approved for construction;
3. A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;
4. The non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;
5. The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;
6. The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments

under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could have been avoided by delaying acquisition until after PPA

execution and the Government's notice to commence acquisition and performance of LERRD; and

7. The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PPA.

We appreciate the County's participation in this project. Should you have questions or concerns pertaining to this letter please feel free to contact Mr. Jerome Morgan at jerome.g.morgan@usace.army.mil (904) 232-1 146.

Sincerely ,



Audrey C. Ormerod
Chief, Real Estate Division

REAL ESTATE CAPABILITY ASSESSMENT

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

FOR LAKE WORTH LAGOON CONTINUING AUTHORITY PROGRAM (CAP) (SEC 1135) PROJECT MODIFICATION

I. Legal Authority:

- a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **No**
- b. Does the sponsor have the power of eminent domain for this project? **No**
- c. Does the sponsor have "quick-take" authority for this project? **No**
- d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **No**
- e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **Yes**

II. Human Resource Requirements:

- a. Will the sponsor's in-house staff require technical training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **No**
- b. If the answer to II a. is "yes," has a reasonable plan been developed to provide such training? **NA**
- c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **Yes**
- d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **Yes**
- e. Can the sponsor obtain contractor support, if required in a timely fashion? **Yes**
- f. Will the sponsor likely request USAGE assistance in acquiring real estate? **No**

III. Other Project Variables:

- a. Will the sponsor's staff be located within reasonable proximity to the project site? **Yes**

b. Has the sponsor approved the project/real estate schedule/milestones?

b. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **Yes**

b. With regard to this project, the sponsor is anticipated to be: **Highly Capable**

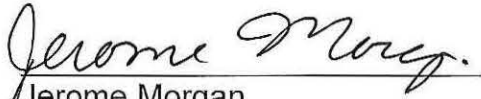
V. Coordination:

a. Has this assessment been coordinated with the sponsor? **Yes**

b. Does the sponsor concur with this assessment? **Yes**

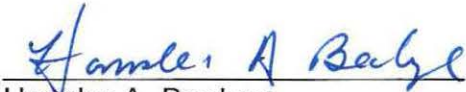
Date: December 6, 2016

Prepared by:



Jerome Morgan
Realty Specialist
Real Estate Division
Jacksonville District

Reviewed by:



Hansler A. Bealyer
Chief, Acquisition Branch
Real Estate Division
Jacksonville District

Reviewed and approved by:



Audrey C. Ormerod
Chief, Real Estate Division
Real Estate Division
Jacksonville District

Appendix D – Environmental
Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) Project

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UNITED STATES DEPARTMENT OF COMMERCE
 National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
 Southeast Regional Office
 263 13th Avenue South
 St. Petersburg, Florida 33701-5505
<http://sero.nmfs.noaa.gov>

F/SER31: DMB

Chief, Environmental Branch
 Planning and Policy Division
 Jacksonville District Corps of Engineers
 Department of the Army
 701 San Marco Boulevard
 Jacksonville, FL 32207-0019

AUG 18 2017

Dear Gina Paduano Ralph:

This letter responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

Applicant	Continuing Authorities Program (CAP) Number	SER Number	Project Type
USACE Jacksonville District	447752	SER-2017-18433	Ecosystem restoration

Consultation History

We received your letter requesting consultation on January 24, 2017. We requested additional information on February 1, March 7, April 12 and 13, May 12, and July 24, 2017. We received final response on July 27, 2017, and consultation was initiated that day. We issued a letter of concurrence on August 8, 2017; however, on August 9, 2017, NMFS was made aware that certain project details in that letter were incorrect. NMFS then worked with USACE to amend the project details. This letter replaces our original letter of concurrence issued on August 8, 2017.

Project Location

Address	Latitude/Longitude	Water body
Lake Worth Lagoon, Palm Beach County, Florida	26.602217°N, 80.042375°W (North American Datum 1983)	Bonefish Cove, Lake Worth Lagoon

Existing Site Conditions

The proposed action is located in Lake Worth Lagoon (LWL) (Figure 1). For the purposes of this consultation, the action area is:

1. The western shore of the Peanut Island Dredged Material Management Area (DMMA) (Figure 2).



2. The 11.8 mile (mi) Intracoastal Waterway (ICWW) transit route between Peanut Island DMMA in north LWL and the project site (Figure 1).
3. The 39 acre (ac) project site at Bonefish Cove within LWL to be filled (Figure 3).

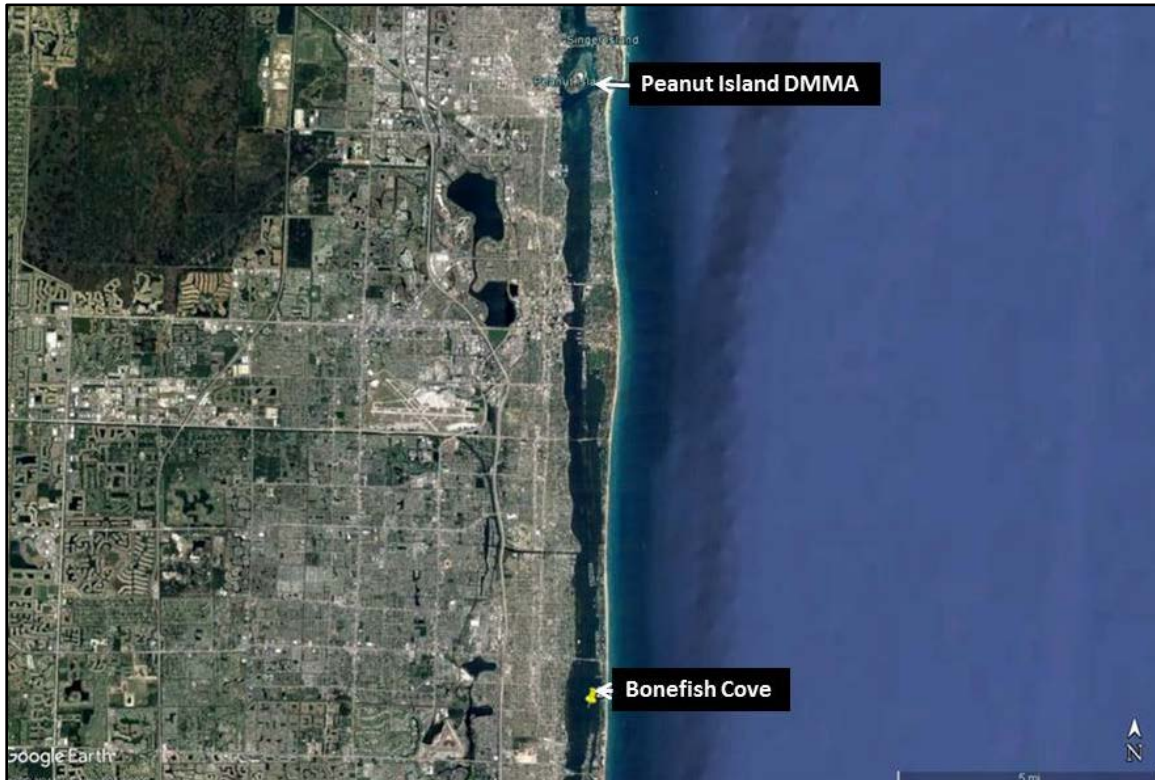


Figure 1. Image showing the entire action area from Peanut Island in north LWL to Bonefish Cove (at location of the pin), approximately 11.8 mi south (©2017 Google Earth).



Figure 2. Peanut Island Dredged Material Management Area. Fill material will be mined from upland and loaded onto barges located at the deep-water access loading/offloading facility on the western shore (©2017 Google Earth).

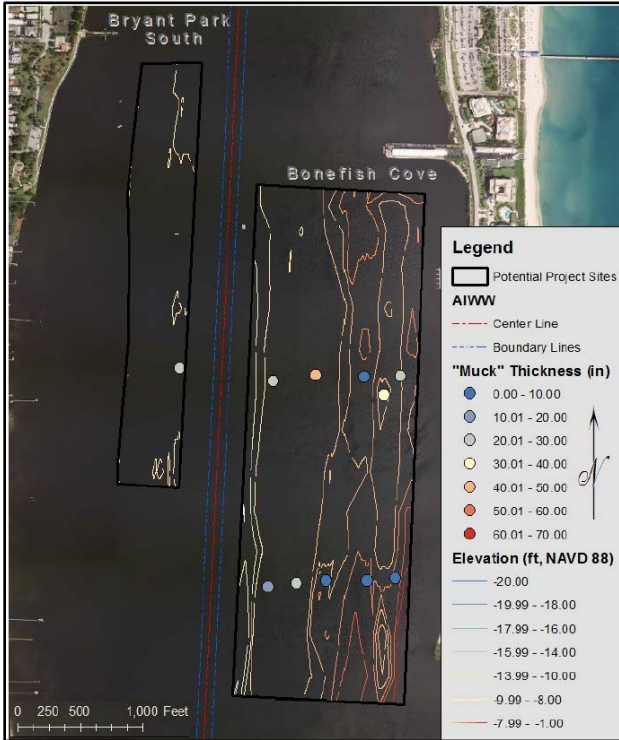


Figure 3. Water depths and surface sediment characteristics the project site at Bonefish Cove (image supplied by USACE).

The action area is located in LWL, a coastal lagoon on the Atlantic Coast of Florida approximately 53 mi south of Ft. Pierce Harbor, and 65 mi north of Miami Harbor. LWL is approximately 21 mi long and up to 1 mi wide; it is separated from the Atlantic Ocean by two barrier islands, Singer Island and Palm Beach Island. Ocean access to LWL is provided by 2 maintained inlets: Lake Worth Inlet (federally maintained; also known as Palm Beach Inlet) and South Lake Worth Inlet (county maintained; also known as Boynton Inlet). The ICWW runs the entire length of the lagoon at a depth of approximately 12 feet (ft). Depths outside of the ICWW within LWL are generally 8 ft mean low water (MLW). Sediment is comprised primarily of sand or shell fragments; however, deposition of fine-grained silt and clay-enriched organic "muck" sediments of greater than 1-ft deep have been observed in over 42 locations within LWL. No corals or hard bottom are present within LWL. Mangrove habitat is found in the north and central portions of LWL around Munyon Island, Peanut Island, John's Island, and Snook Island largely due to restoration projects in those areas. Multiple seagrass species are found in greater LWL, including Johnson's seagrass, manatee grass, shoal grass, paddle grass, and turtle grass. LWL contains patches of healthy oyster beds occurring both naturally and as a result of restoration projects.

Peanut Island is located in the Lake Worth Lagoon (LWL) just west of the Lake Worth Inlet. Since 1934, USACE has maintained the Palm Beach Harbor Navigation Project and has used Peanut Island DMMA as a disposal site for material dredged from the ICWW. The material at Peanut Island DMMA consists of sand mixed with rock or finer sediments and is not suitable for beach disposal. Today, Peanut Island is a 79 ac island that contains the DMMA on the interior, public recreational facilities along the perimeter, and historical interests (e.g., Palm Beach Maritime Museum). There is an existing loading/offloading facility with deep-water access.

Bonefish cove is located approximately 11.8 mi south of the Peanut Island DMMA. The current water depths at Bonefish Cove range from 1 to 14 ft MLW and bottom substrate is characterized by 0-4 ft of muck. A benthic survey was performed across Bonefish Cove at 38 locations along 9 transects. While patchy seagrass habitat is located west across the ICWW (Figure 4), there were no corals, hard bottom, or sea grasses observed at any of the 38 locations within the project site.

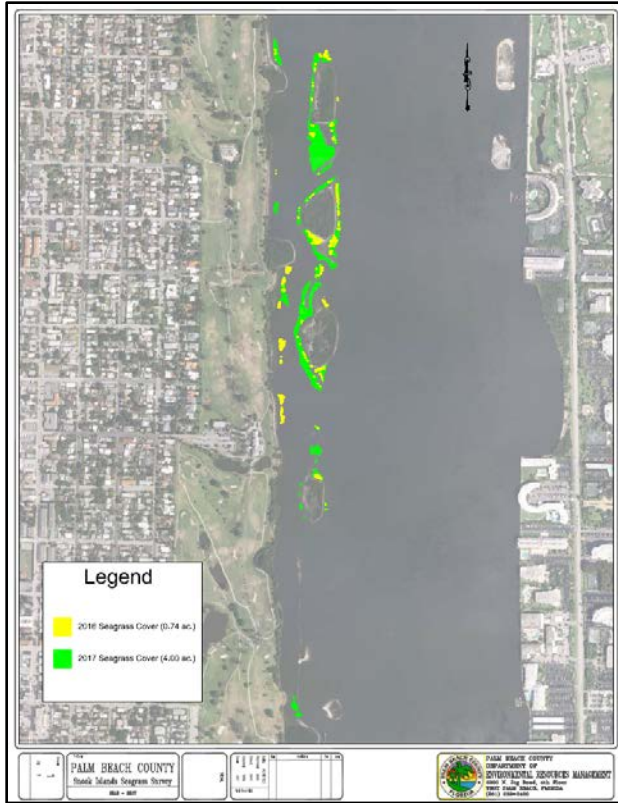


Figure 4. Seagrass coverage near the project site for 2016 and 2017 (image supplied by USACE).

Project Description

The objective of the project is to improve the benthic habitat and marine ecosystem conditions of LWL under the continuing authority provided by Section 1135 of the Water Resources Development Act of 1986. The U.S. Army Corps of Engineers proposes to:

1. Mine 345,000 yd³ of fill material from upland portions of the Peanut Island DMMA and transport the material 11.8 mi to Bonefish Cove.
2. Fill approximately 39 ac of water bottoms in LWL at Bonefish Cove to create approximately 8.7 ac of mangrove islands (3 islands total), 1.2 ac of oyster reef, and 29.2 ac of potential seagrass habitat with elevations of -5.5 feet NAVD and shallower (Figure 5).
3. Install approximately 5,416 tons of 2-3 ft diameter limestone boulder riprap along the perimeter of each mangrove island to protect it from erosion resulting from vessel traffic in the ICWW.
4. Install 56 prefabricated reef modules in the interior base of the mangrove islands approximately 1 ft below MLW.

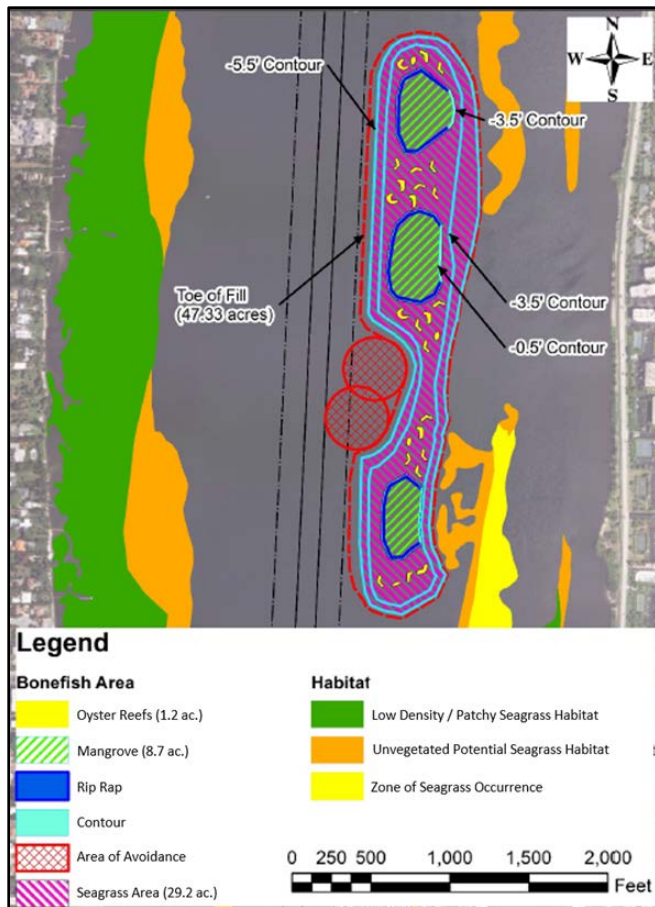


Figure 5. Overall plan view of the proposed island creation project in Bonefish Cove (image supplied by USACE). Refer to Figure 4 for 2016-2017 seagrass cover.

USACE does not normally dictate means and methods. This is generally left to industry to offer the most efficient, appropriate, and competitive methods and/or equipment available at the time. Construction methods will likely follow similarly completed projects in the Lake Worth Lagoon area, such as Snook Island. Given this, the fill material is expected to be excavated from Peanut Island DMMA and loaded in a barge with a conveyor. Equipment used at the island will be heavy equipment only. The loaded material will be transported via barge 11.8 miles from Peanut Island to the project site. The material will be unloaded at the project site with an excavator on a flat barge. The excavator will load a conveyor system for the final delivery. While these were the assumptions prepared by USACE to determine the government cost estimate, contractors bidding on the project may offer alternative methods for mining the material, transporting the material to the project site, and unloading the material at the project site. If the means and methods included in the awarded contract differ significantly from those proposed during the cost estimation process and included in this analysis, USACE will reinitiate consultation.

Post-construction activities will include planting mangroves (small trees and/or propagules) on the newly created islands. See Figure 6 for an example of how each island may look prior to mangrove planting. Oysters and seagrass will not be planted; it is anticipated that limestone boulder riprap, prefabricated reef modules, and elevated substrates will provide enough benefit for natural recruitment similar to other Federal projects in LWL.



Figure 6. Image of a similar project site prior to planting, showing an example of the rip-rap shoreline used for island stabilization and protection (image supplied by USACE)

Construction Conditions

The applicant proposes the following construction conditions:

1. Work will comply with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006,¹ including the use of turbidity curtains.
2. The project will obtain water quality certification from the state of Florida's Department of Environmental Protection during the design and construction phase of the project, prior to initiation of construction. Work vessels will travel at "no wake/idle" speeds at all times (< 5 knots) and in sufficient water depths to prevent potential seagrass prop scarring.
3. The town of Palm Beach will be listed in the project specifications as the entity setting operational hours and lighting restrictions in compliance with local ordinances. The town will likely impose operational hours and lighting restrictions on the awarded contract for work occurring within the town's limits. It is assumed that construction will be executed during day light hours and only five days a week.
4. Openings in the pre-fabricated reef modules will be 7-22 inches in diameter, small enough to avoid sea turtle entrapment and large enough to create habitat for small fishes and oyster and follow Project Design Criteria (PDCs) for Aquatic Habitat Enhancement,

¹ NMFS. 2006. *Sea Turtle and Smalltooth Sawfish Construction Conditions* revised March 23, 2006. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida.
http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/sea_turtle_and_smalltooth_sawfish_construction_conditions_3-23-06.pdf, accessed June 2, 2017.

Establishment, and Restoration Activities outlined in the Florida Statewide Programmatic Biological Opinion (SWPBO)²

Construction is estimated to take up to 18 months. Post-construction environmental and physical monitoring will be conducted following Palm Beach County Adaptive Management Plan for the Lake Worth Lagoon 1135 CAP Project.

Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic and South Atlantic distinct population segment [DPS])	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean DPS)	T	NLAA	NLAA
Hawksbill	E	NLAA	NE
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Invertebrate			
Johnson's seagrass	T	NLAA	NE
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; NE = no effect			

We believe the project will have no effect on hawksbill and leatherback sea turtles, due to the species' very specific life history strategies, which are not supported at the project site. Leatherback sea turtles have pelagic, deepwater life history, where they forage primarily on jellyfish. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges.

We believe the project will have no effect on Johnson's seagrass because the species is not located at the Peanut Island DMMA loading/offloading facility or within or near the Bonefish Cove project site. Additionally, it is unlikely that seagrasses are present in the ICWW transit route due to water depth. Even if seagrass is present, we do not anticipate any impacts to seagrass in the ICWW transit route because work vessels will travel in sufficient water depths to prevent potential seagrass prop scarring.

Critical Habitat

The project is not located in designated critical habitat, and there are no potential routes of effect to any designated critical habitat.

² NMFS. Florida Statewide Programmatic Biological Opinion (SER-2014-12540), December 4, 2015, http://sero.nmfs.noaa.gov/protected_resources/section_7/freq_biop/documents/reg_bo/swpbo-_signed_copy.pdf

Analysis of Potential Routes of Effects to Species

Physical injury: Potential effects to sea turtles and smalltooth sawfish include the risk of injury from construction and transit activities, which will be discountable due to the species' likelihood and ability to move away if disturbed. The applicant's implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers to watch for sea turtles and smalltooth sawfish. Operation of all mechanical construction equipment will cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition.

Potential effects to sea turtles also include the risk of entrapment in reef modules. The proposed reef modules will have several openings (diameter 7-22 in) and a closed bottom. Further, the applicant will follow all PDCs for Aquatic Habitat Enhancement, Establishment, and Restoration Activities outlined in the SWPBO which requires reef structures, materials, and installation methods be designed and deployed to prevent entanglement and entrapment of listed species. Based on these requirements, the risk of entrapment from artificial reefs is highly unlikely to occur and therefore discountable.

Turbidity effects: Increased turbidity could directly affect sea turtles and sawfish health. Turbidity could also affect forage resources and habitats used by these species. Because material will be mined from upland portions of the DMMA via land-based operations, we do not expect any turbidity to result from that portion of the work. Likewise, we do not expect any turbidity to result from the transport of the material from the DMMA to Bonefish Cove. Localized and temporary increased turbidity could result from the placement of the material at the Bonefish Cove site. Because the fill material is sandy and coarse, we anticipate clean sand particles to settle quickly without spreading into the surrounding habitat. The applicant will also use turbidity curtains for the duration of the project. Fill material will be placed in such a manner as to minimize or avoid any turbidity effects to the maximum extent practicable. Water quality will be protected by adherence to the state of Florida's water quality certification requirements. Therefore, the effects of a potential increase in turbidity to listed species or the surrounding habitat is highly unlikely and discountable.

Habitat effects: Sea turtles and smalltooth sawfish may be affected by their inability to access the action area for foraging and refuge, due to their avoidance of construction activities and physical exclusion from areas blocked by turbidity curtains. There is additional suitable habitat nearby for foraging and refuge. Further, these effects will be temporary, with total in-water work lasting up to 18 months and limited to day light hours, and highly localized. Therefore, the effects of any potential short-term displacement or exclusion due to project activities are insignificant.

The construction of the mangrove islands will permanently alter habitat containing listed species' prey, such as crustaceans, mollusks, and finfish. Given the project's relatively small footprint in relation to the availability of similar habitat nearby, the permanent loss of foraging habitat is insignificant.

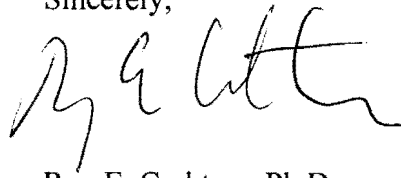
Over time, the mangrove islands may provide benefits to listed sea turtles and smalltooth sawfish by enhancing the diversity of available prey. This may happen by the creation of patchwork oyster reefs that, over time, provide more diverse and structurally complex habitat for prey species.³ As these prey species increase in abundance in the shallow nearshore project area, there will be a spill-over effect to neighboring areas that are deeper than 6 ft.⁴ Additionally, the elevated substrate provides habitat for natural seagrass recruitment which, over time, would provide forage and refuge habitat for sea turtles and smalltooth sawfish. Colonization of riprap by algae and sponges can also provide forage resources for sea turtles. Therefore, the construction of the mangrove islands and placement of rip-rap may be beneficial to listed sea turtles and smalltooth sawfish the long-term.

Conclusion

Because all potential project effects to listed species were found to be discountable, insignificant, or beneficial, we conclude that the proposed action is not likely to adversely affect listed species under NMFS's purview. This concludes your consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Dana M. Bethea, Consultation Biologist, at (727) 209-5974, or by email at Dana.Bethea@noaa.gov.

Sincerely,



Roy E. Crabtree, Ph.D.
Regional Administrator

File: 1514-22.F.4

³ Boudreaux, M. L., J. L. Stiner, and L. J. Walters. 2006. Biodiversity of Sessile and Motile Macrofauna on Intertidal, Oyster Reefs in Mosquito Lagoon, Florida. *Journal of Shellfish Research* 25(3):1079-1089.

⁴ Seitz, R., R. Lipcius, N. Olmstead, M. Seebo, and D. Lambert. 2006. Influence of shallow-water habitats and shoreline development on abundance, biomass, and diversity of benthic prey and predators in Chesapeake Bay. *Marine Ecology Progress Series* 326:11-27.



UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office

263 13th Avenue South

St. Petersburg, Florida 33701-5505

<http://sero.nmfs.noaa.gov>

June 27, 2017

F/SER47:KG/pw

(Sent via Electronic Mail)

Colonel Jason A. Kirk, Commander
U.S. Army Corps of Engineers, Jacksonville District
Planning and Policy Division, Environmental Branch
701 San Marco Boulevard
Jacksonville, Florida 32207-0019

Attention: Kristen L. Scheler

Dear Colonel Kirk:

NOAA's National Marine Fisheries Service (NMFS) reviewed the letter dated June 16, 2017, from the Jacksonville District regarding the Draft Integrated Feasibility Report/Environmental Assessment (DIFR/EA) entitled *Lake Worth Lagoon, Continuing Authorities Program (CAP) Section 1135 Project*. The Jacksonville District plans to create islands, mangrove planters, and oyster reef habitat in Lake Worth Lagoon to address the discharge of freshwater and deposition of fine organic sediments from the C-51 Canal resulting from operation of the Central and South Florida Project. The letter replies to conservation recommendations the NMFS provided by letter dated April 25, 2017, to protect essential fish habitat (EFH). The NMFS recommended:

1. Inclusion of management measures that address the fine sediments and freshwater pulses from the C-51 Canal.
2. Replacing the existing, bottom discharging structure at S-155 with one that discharges over the top and conducting seasonal maintenance dredging at the S-155 structure to remove the accumulated fine grained sediments.
3. Inclusion in the Final IFR/EA of references to the source documents regarding success at SINA Area and inclusion of the most recent information on seagrass abundance and distribution at SINA in discussions of how SINA applies to Bonefish Cove.
4. Inclusion in the Final IFR/EA an analysis of how the addition of 57,000 cubic yards of muck and silt from the Town of Palm Beach dredging project would affect habitat restoration at Bonefish Cove

The District's letter states addressing recommendations #1 and #2 would be outside the scope of the current project. The NMFS maintains the importance of addressing the sources of environmental degradation prior to attempting restoration; otherwise, the long-term effect of the project may be negligible.

The District's response to conservation recommendation #3 indicates the DIFR/EA relied on Snook Islands Natural Area (SINA) monitoring reports from 2010. While the NMFS agrees the SINA met the performance standards set in the permit at that time, seagrass coverages at the site



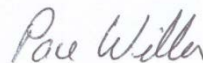
plummeted since due to the changes in environmental conditions the NMFS described in the previous letter. The NMFS maintains the information used to forecast the outcome of the Bonefish Cove project should include the more recent monitoring information from SINA.

Regarding conservation recommendation #4, the District's response included a description of the project planning processes for the Bonefish Cove project and the Town of Palm Beach dredging project, including a meeting on April 28, 2017, where the District, Town of Palm Beach, and NMFS discussed coordination of the two efforts. The NMFS is satisfied with the coordination and conclusion that the Town's project will not interfere with the CAP project.

Section 305(b)(4)(B) of the Magnuson-Stevens Act and 50 CFR 600.920(k)(1) require federal agencies to provide the NMFS with a detailed response when EFH conservation recommendations are provided and for the response to include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. While the District has met this procedural requirement, the project appears to fall short of taking all practicable measures to conserve EFH. The NMFS acknowledges the District evaluates a broad range of actions under the public interest review, and if that review ultimately favors authorizing the project, the NMFS requests a copy of final decision document.

Thank you for the opportunity to provide comments. Related correspondence should be directed to the attention of Mr. Kurtis Gregg at our West Palm Beach office, 400 North Congress Avenue, Suite 110, West Palm Beach, Florida, 33401. He may be reached by telephone at (561) 249-1627, or by e-mail at Kurtis.Gregg@noaa.gov.

Sincerely,



/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc: COE, KristenLScheler@usace.army.mil
FWS, Ashleigh_Blackford@fws.gov
EPA, Miedema.Ron@epa.gov
PBC, DCarson@pbcgov.org, MMitchell@pbcgov.org
FWCC, Lisa.Gregg@MyFWC.com
FDEP ERP, Jason.Andreotta@dep.state.fl.us
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Jocelyn.Karazsia@noaa.gov, Kurtis.Gregg@noaa.gov



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

JUN 16 2017

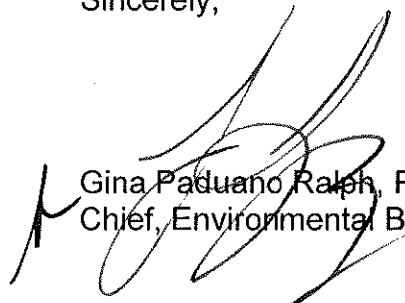
Ms. Virginia Fay
Assistant Regional Administrator
Habitat Conservation Division
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, Florida 33701-5505

Dear Ms. Fay:

This letter acknowledges the U. S. Army Corps of Engineers (Corps), Jacksonville District, receipt of your April 25, 2017 letter regarding the Essential Fish Habitat (EFH) consultation for the Draft Integrated Feasibility Report and Environmental Assessment for Lake Worth Lagoon, Continuing Authorities Program Project in Palm Beach County, Florida. The Corps has reviewed and considered the concerns and recommendations presented by National Marine Fisheries Service (NMFS) in its letter, and has prepared the enclosed responses to these recommendations in accordance with the intentions of 50 CFR 600.920(k)(2) under the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA).

The Corps appreciates the input provided by NMFS on this project to develop measures that avoid impacts to NMFS trust resources. The submission of the enclosed responses completes the Corps' requirements for EFH consultation under the MSFCMA's EFH provisions. If NMFS does not agree that the consultation requirements are complete, NMFS has 10 days from the date of this letter to elevate any remaining concerns. Any questions regarding this project should be directed to Kristen Scheler at the letterhead address or by telephoning 904-232-2918.

Sincerely,


Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosure

ENCLOSURE 1

Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for Lake Worth Lagoon, Continuing Authorities Program, Section 1135 Project Palm Beach County, Florida

U.S. Army Corps of Engineers (Corps), Jacksonville District Responses to National Marine Fisheries Service (NMFS) Essential Fish Habitat (EFH) Conservation Recommendations

NMFS EFH conservation recommendations are listed below along with their individual responses.

1. Inclusion of management measures that address the fine sediments and freshwater pulses from the C-51 canal.

The Continuing Authorities Program (CAP) section 1135 – Project Modifications for Improvement of the Environment (Water Resources Development Act (WRDA) of 1986) authorizes the Corps to assist in the restoration of degraded ecosystems through the modification of USACE structures, operations, or implementation of measures in affected areas. The CAP program also requires a Non-federal Sponsor to request assistance and be willing to fund half the total cost through construction. The maximum federal limit is \$10 million per section 1135 project. At this time, Palm Beach County has requested assistance in restoration efforts for Lake Worth Lagoon through capping and raising bottom elevations allowing for seagrass habitat to be created. Inclusion of management measures that address the fine sediments and freshwater pulses from the C-51 canal falls outside the current scope of this project.

2. Replacing the existing, bottom discharging structure at S-155 with one that discharges over the top and conducting seasonal maintenance dredging at the S-155 structure to remove the accumulated fine grained sediments.

CAP section 1135 – Project Modifications for Improvement of the Environment (WRDA 1986) authorizes the Corps to assist in the restoration of degraded ecosystems through the modification of USACE structures, operations, or implementation of measures in affected areas. The CAP program also requires a Non-federal Sponsor to request assistance and be willing to fund half the total cost through construction. The maximum federal limit is \$10 million per section 1135 project. At this time, Palm Beach County has requested assistance in restoration efforts for Lake Worth Lagoon through capping and raising bottom elevations allowing for seagrass habitat to be created. Replacement of the existing, bottom discharging structure at S-155 falls outside the current scope of this project.

3. Inclusion in the Final IFR/EA of references to the source documents regarding success at Snook Islands Natural Area (SINA) and inclusion of the most recent information on seagrass abundance and distribution at SINA in discussions of how SINA applies to Bonefish Cove.

The SINA monitoring report information will be added to the IFR/EA's reference list. The Lake Worth Lagoon (LWL) project is based on SINA restoration. SINA construction was completed during the summer of 2005 and included placement of fill, placement of limestone boulder riprap, and the planting of emergent grasses and mangroves. The raised elevations from the fill placement was designed and constructed to create seagrass habitat and was expected to result in natural recruitment of seagrasses. Placement of the limestone boulder riprap was designed and constructed to create oyster reef habitat and was expected to result in the natural recruitment of oysters. The SINA 2010 monitoring report tracks and compares annual results from 2006 through 2010 for emergent grasses, mangroves, oysters, and seagrasses. The results of the 2010 report indicate successful recruitment and growth trends over the 5-year monitoring period. The LWL project also includes a 5-year monitoring plan to track the post construction annual changes of the project's mangroves, oysters, and seagrasses. A seagrass restoration area, comparable to the growth and recruitment documented in the SINA 2010 report, would be attained by utilizing similar design and construction means and methods implemented by SINA.

4. Inclusion in the Final IFR/EA an analysis of how the addition of 57,000 cubic yards of much and silt from the Town of Palm Beach dredging project would affect habitat restoration at Bonefish Cove.

The construction of a CAP project includes study approval followed by design and implementation only after appropriations are acquired. There is the potential that approvals or appropriations may not occur that meet the expectations of all stakeholders. Like NMFS, the Corps is on a 24 month budget cycle and it is sometimes difficult to anticipate the programs or projects to receive appropriations. Our responsibility is to communicate these typical project risks as we do not control actions taken by private entities. The proposed placement of maintenance dredged material at Bonefish Cove is a separate and distinct action from the Corps' 1135 CAP project; therefore, the town's project must be constructed with independent utility. Even if the permit is issued to place dredged material at Bonefish Cove, the restoration benefits will only be realized through the implementation of the CAP project. The LWL 1135 CAP project's existing conditions were evaluated on the known environment and features currently present in the project area and vicinity at the time the report was written. A pre-construction survey to confirm bathymetry and volume calculations will be performed during the project's Design and Implementation phase. If the town of Palm Beach's project is permitted and constructed prior to the CAP project's construction, changes in the existing conditions would be identified and adjustments to the CAP project's design would be incorporated. The Corps will revisit analysis and determine whether additional coordination with NMFS may be needed at that time.



UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office

263 13th Avenue South

St. Petersburg, Florida 33701-5505

<http://sero.nmfs.noaa.gov>

April 25, 2017

F/SER47:KG/pw

Colonel Jason A. Kirk, Commander
U.S. Army Corps of Engineers, Jacksonville District
Planning and Policy Division, Environmental Branch
701 San Marco Boulevard
Jacksonville, Florida 32207-0019

Attention: Kristen L Scheler

Dear Colonel Kirk:

NOAA's National Marine Fisheries Service (NMFS) reviewed the Draft Integrated Feasibility Report/Environmental Assessment (DIFR/EA) entitled *Lake Worth Lagoon, Continuing Authorities Program (CAP) Section 1135 Project* and dated February 2017. To address the discharge of freshwater and deposition of fine organic sediments from the C-51 Canal, the Jacksonville District plans to create islands, mangrove planters, and oyster reefs in Lake Worth Lagoon, Palm Beach County. The discharge and deposition result from operation of the Central and South Florida Project. The Jacksonville District's preliminary conclusion is the proposed restoration of deep dredge holes in Lake Worth Lagoon would not have a substantial adverse effect on approximately 47.5 acres of essential fish habitat (EFH). As the nation's Federal trustee for the conservation and management of marine, estuarine, and anadromous fishery resources, the NMFS provides the following comments and recommendations pursuant to authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Essential Fish Habitat within Lake Worth Lagoon

EFH in Lake Worth Lagoon includes estuarine bottom, oyster, hard bottom, mangrove, coral, and seagrass habitats. The South Atlantic Fishery Management Council (SAFMC) identifies estuarine bottom, oyster, mangrove, coral, and seagrass habitats as EFH for several species, including adult white grunt (*Haemulon plumieri*); juvenile and adult gray snapper (*Lutjanus griseus*); juvenile mutton snapper (*Lutjanus analis*); and larval and juvenile pink shrimp (*Farfantepenaeus duorarum*). SAFMC also designates coral and seagrass as a Habitat Area of Particular Concern (HAPC) for several species within the snapper/grouper complex. HAPCs are subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. Seagrass directly benefit fishery resources of Lake Worth Lagoon by providing water quality benefits, foraging opportunities, and nursery habitat. Further, seagrass is part of a habitat complex that includes sand bottom, oysters, mangroves, hardbottom, and coral reefs. This complex supports a diverse community of fish and invertebrates within the Lagoon. The SAFMC provides additional information on EFH and HAPCs and their support of federally managed fishery species in *Fishery Ecosystem Plan of the South Atlantic Region* (available at www.safmc.net).

Alternatives Analysis

The DIFR/EA indicates the Central and South Florida Project affects habitats in Lake Worth Lagoon via the C-51 Canal through rapid salinity fluctuations and deposition of fine, organic sediments. Non-structural measures that would address the freshwater fluctuations and fine sediment deposition were



removed from consideration at the preliminary screening phase. The alternatives analysis evaluates restoration of estuarine habitats at the El Cid and Bonefish Cove locations in Lake Worth Lagoon without addressing the C-51 Canal as the source of the environmental degradation.

The NMFS supports restoration of estuarine habitat in Lake Worth Lagoon. The DIFR/EA describes the advantages and challenges from selecting the Bonefish Cove restoration site over the El Cid location. The District anticipates the proposed filling of the dredged hole, capping the existing muck with sand, and creating islands with a riprap shoreline for oyster habitat and protection of mangroves would allow recruitment of seagrass. The proposed project is similar to work completed at the Snook Islands Natural Area (SINA), which also is affected by the C-51 Canal. The SINA project provides lessons learned that should be incorporated into the present project. While the SINA project met the performance standards set in state and federal permits, the restoration has not resulted in a self-sustaining component of the ecosystem (e.g., nearly all the seagrass disappeared from the SINA after increased rainfall after permit compliance was established). This distinction is important because the DIFR/EA forecasts success of the Bonefish Cove restoration based on the perceived success at SINA. The DIFR/EA neither acknowledges the fluctuations occurring at SINA nor considers them when forecasting the outcomes of the proposed Bonefish Cove project.

The NMFS recommends reconsideration of management measures affecting the sources of environmental conditions adversely affecting EFH in Lake Worth Lagoon. One such management measure would be to replace the existing, bottom discharging structure at S-155 with one discharging over the top. The bottom discharging structure currently in use, releases accumulated fine-grained sediments every time the structure is opened. Replacing this structure with an easily maintained sediment trap would significantly reduce the sediment load to Lake Worth Lagoon.

Lastly, the NMFS recently received a public notice (SAJ-2013-01640) regarding a proposal from the Town of Palm Beach to dispose of 57,000 cubic yards of dredged muck and silt in the Bonefish Cove project area. The DIFR/EA should include an analysis of how this additional muck and silt would affect the estuarine habitat restoration project proposed at the Bonefish Cove location.

EFH Conservation Recommendations

Section 305(b)(4)(A) of the Magnuson-Stevens Act requires the NMFS to provide EFH Conservation Recommendations for any federal action or permit which may result in adverse impacts to EFH. Therefore, the NMFS recommends the following to ensure the conservation of EFH and associated fishery resources:

EFH Conservation Recommendations

1. Inclusion of management measures that address the fine sediments and freshwater pulses from the C-51 Canal.
2. Replacing the existing, bottom discharging structure at S-155 with one that discharges over the top and conducting seasonal maintenance dredging at the S-155 structure to remove the accumulated fine grained sediments.
3. Inclusion in the Final IFR/EA of references to the source documents regarding success at SINA Area and inclusion of the most recent information on seagrass abundance and distribution at SINA in discussions of how SINA applies to Bonefish Cove.
4. Inclusion in the Final IFR/EA an analysis of how the addition of 57,000 cubic yards of muck and silt from the Town of Palm Beach dredging project would affect habitat restoration at Bonefish Cove.

Thank you for the opportunity to provide comments. Related correspondence should be directed to the attention of Mr. Kurtis Gregg at our West Palm Beach office, 400 North Congress Avenue, Suite 110, West Palm Beach, Florida, 33401. He may be reached by telephone at (561) 249-1627, or by e-mail at Kurtis.Gregg@noaa.gov.

Sincerely,



/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc: COE, Kristen.L.Scheler@usace.army.mil
FWS, Ashleigh_Blackford@fws.gov
EPA, Miedema.Ron@epa.gov
FWCC, Lisa.Gregg@MyFWC.com
FDEP ERP, Jason.Andreotta@dep.state.fl.us
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Jocelyn.Karazsia@noaa.gov, Kurtis.Gregg@noaa.gov

RECEIVED

2017-TPA-0218



REPLY TO
ATTENTION OF

JAN 23 2017
South Florida ES Office
Vero Beach, FL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT CORPS OF ENGINEERS

701 SAN MARCO BOULEVARD

JACKSONVILLE, FLORIDA 32207-0048

JA

Planning and Policy Division
Environmental Branch

Roxanna Hinzman
Field Supervisor
South Florida Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960



U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
772-562-3909 Fax 772-562-4288

FWS Log No. 04EF2000-2017-I-0218

The U.S. Fish and Wildlife Service has reviewed the information provided and finds that the proposed action is not likely to adversely affect any federally listed species or designated critical habitat protected by the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 et. seq.). A record of this consultation is on file at the South Florida Ecological Service Office.

This fulfills the requirements of section 7 of the Act and further action is not required. If modifications are made to the project, if additional information involving potential effects to listed species becomes available, or if a new species is listed, reinitiation of consultation may be necessary.

Roxanna Hinzman
for Roxanna Hinzman, Field Supervisor

3/15/17
Date

Dear Ms. Hinzman:

In order to comply with Section 7 of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), the U.S. Army Corps of Engineers (Corps), Jacksonville District, respectfully requests a letter of concurrence from the U.S. Fish and Wildlife Service (USFWS) on the Lake Worth Lagoon Section 1135 Continuing Authorities Program (CAP) Project.

Historic freshwater discharges into Lake Worth Lagoon sustained an ecologically appropriate range of salinity conditions and nutrient levels to facilitate the presence of healthy floral and faunal communities. As south Florida developed, the need to protect against flooding and support increased water supply for communities led to the construction of a canal network, part of the Central and Southern Florida Project (C&SF). Although the canal network is efficient at reducing flood damages and meeting water supply needs, drastic salinity changes caused by freshwater pulses and contaminated runoff have degraded the biological integrity in Lake Worth Lagoon. The objective of the Lake Worth Lagoon Project is to improve the benthic habitat and marine ecosystem conditions of the lagoon within the limited authority of the CAP 1135 Program.

Description of the Project Location and Proposed Action

The Lake Worth Lagoon Project is located in south central Florida in Palm Beach County. Restoration activities include creation of small mangrove islands by filling dredge holes, placement of a thin layer of sand on muck sediment to create seagrass habitat, and the placement of prefabricated reef modules for the creation of oyster reef habitat.



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

CESAJ-PD-E (ER 200-2-2)

23 MAR 2017

MEMORANDUM FOR THE RECORD

SUBJECT: Coordination Act Report for the Lake Worth Lagoon 1135 Continuing Authorities Program (CAP) project in Palm Beach County, Florida

PURPOSE: To document an informal understanding between the U.S. Army Corps of Engineers (Corps), Jacksonville District, and the U.S. Fish and Wildlife Service (Service), South Florida Ecological Services Field Office.

Background. Historic freshwater discharges into Lake Worth Lagoon sustained an ecologically appropriate range of salinity conditions and nutrient levels to facilitate the presence of healthy floral and faunal communities. As south Florida developed, the need to protect against flooding and support increased water supply for communities led to the construction of a canal network, part of the Central and Southern Florida Project. Although the canal network is efficient at reducing flood damages and meeting water supply needs, drastic salinity changes caused by freshwater pulses and contaminated runoff have degraded the biological integrity in Lake Worth Lagoon. The objective of the Lake Worth Lagoon Project is to improve the benthic habitat and marine ecosystem conditions of the lagoon within the limited authority of the CAP 1135 Program.

Tentatively Selected Plan (TSP). The project's TSP consists of creating three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of 2' x 3' pre-fabricated reef modules scattered around the islands. Fill material to be used for the project will be excavated and transported from Peanut Island Dredged Material Management Area (DMMA) – the same sediment source used for creating similar nearby projects, Snook Islands and Grassy Flats. Peanut Island is 11.8 miles away from the Bonefish Cove site.

Coordination. The Fish and Wildlife Coordination (FWCA; 16 U.S.C. 661 et seq., March 10, 1934, as amended 1946, 1958, 1978, and 1995) requires Federal agencies to consult with the Service regarding the impacts to fish and wildlife resources and the proposed measures to mitigate these impacts. Additional coordination authorities exist through the review process of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321-4347, January 1, 1970, as amended 1975 and 1982) and the consultations required under the Endangered Species Act of 1973 (ESA; 7 U.S.C. 136, 16 U.S.C. 1531 et seq. December 28, 1973).

CESAJ-PD-E (ER 200-2-2)

SUBJECT: Coordination Act Report for the Lake Worth Lagoon 1135 Continuing Authorities Program (CAP) project in Palm Beach County, Florida

The Service continues to coordinate and consult with the Corps through NEPA and the ESA in which impacts to fish and wildlife resources are adequately addressed via these two authorities. The Service will include comments relevant to FWCA in the Services response to the Corps' ESA coordination letter.

Agreement. The undersigned, Corps and the Service, agree to utilize the Lake Worth Lagoon 1135 CAP project NEPA review and ESA consultation processes to complete coordination responsibilities under the FWCA. This agreement will avoid duplicate analysis and documentation as authorized under 40 CFR section 1500.4 (k), 1502.25, 1506.4, and is consistent with Presidential Executive Order for Improving Regulation and Regulatory Review, released January 18, 2011.



Roxanna Hinzman
Field Supervisor
South Florida Field Office



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-0019

REPLY TO
ATTENTION OF

JAN 20 2017

Planning and Policy Division
Environmental Branch

Roxanna Hinzman
Field Supervisor
South Florida Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

Dear Ms. Hinzman:

In order to comply with Section 7 of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), the U.S. Army Corps of Engineers (Corps), Jacksonville District, respectfully requests a letter of concurrence from the U.S. Fish and Wildlife Service (USFWS) on the Lake Worth Lagoon Section 1135 Continuing Authorities Program (CAP) Project.

Historic freshwater discharges into Lake Worth Lagoon sustained an ecologically appropriate range of salinity conditions and nutrient levels to facilitate the presence of healthy floral and faunal communities. As south Florida developed, the need to protect against flooding and support increased water supply for communities led to the construction of a canal network, part of the Central and Southern Florida Project (C&SF). Although the canal network is efficient at reducing flood damages and meeting water supply needs, drastic salinity changes caused by freshwater pulses and contaminated runoff have degraded the biological integrity in Lake Worth Lagoon. The objective of the Lake Worth Lagoon Project is to improve the benthic habitat and marine ecosystem conditions of the lagoon within the limited authority of the CAP 1135 Program.

Description of the Project Location and Proposed Action

The Lake Worth Lagoon Project is located in south central Florida in Palm Beach County. Restoration activities include creation of small mangrove islands by filling dredge holes, placement of a thin layer of sand on muck sediment to create seagrass habitat, and the placement of prefabricated reef modules for the creation of oyster reef habitat.

Listed Species Under USFWS Jurisdiction

Listed species which may occur in the vicinity of the proposed work and are under the jurisdiction of the USFWS include the West Indian (Florida) manatee (*Trichechus manatus latirostris*) - Endangered (CH).

Potential Effects to Listed Species and Efforts to Eliminate/Avoid Impacts

West Indian (Florida) Manatee

The Florida manatee (*Trichechus manatus latirostris*) is a subspecies of the West Indian manatee. *Trichechus manatus* has been listed as a protected mammal in Florida since 1893. Federal law, specifically the Marine Mammal Protection Act of 1972 (MMPA) and the 1973 ESA protects manatees. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act, designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways.

Critical habitat is defined under the ESA as specific areas within and/or outside a geographical area that are occupied by a species at the time of listing, that contain physical or biological features essential to the conservation of the species and therefore require special management considerations or protection for the benefit of the species. All of Lake Worth Lagoon is designated as critical habitat for the manatee under the 1976 ESA (50 CFR 17.95(a)). Although no specific primary constituent elements were included in the initial critical habitat designation, habitat requirements currently present in Lake Worth Lagoon to sustain manatees' essential life history functions likely include:

- Shallow, secluded water areas for resting, mating, and calving
- Submerged, emergent, and floating vegetation for foraging
- Freshwater source for drinking (natural or artificial sources)
- Unobstructed transiting corridors to warm-water refugia due to manatees' sensitivity to low water temperatures

During the winter months when temperatures drop, manatees will migrate to warmer waters, including the Florida Power and Light Riviera Power plant outflows, which is located north of the project area. During the spring months when the water warms, manatees return to the counties to the north and south to forage and reproduce.

Creation of mangrove islands and sea grass and oyster reef habitat will occur within manatee critical habitat; however, the conversion of subtidal habitat to mangrove islands and seagrass and oyster reef habitat will result in increased foraging habitat. The shallower depths may also be used for resting, mating, and calving. Applicable

standard protective measures will be taken during in-water construction activities to ensure the safety of manatees in the project vicinity (see Attachment 1).

Effect Determination

The Corps determination is that the proposed action may affect but is not likely to adversely affect the West Indian (Florida) manatee.

The Corps respectfully requests that USFWS provide a letter of concurrence within 30 days of the receipt of this letter. If you have any questions, or need additional information, please contact Kristen Scheler by email Kristen.L.Scheler@usace.army.mil or telephone 904-232-2918. Thank you for your assistance.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch
Planning and Policy Division

Enclosure

Lake Worth Lagoon 1135 Continuing Authorities Program (CAP) Project

ATTACHMENT 1:

MANATEE STANDARD CONDITIONS FOR IN-WATER WORK (2011)

STANDARD MANATEE CONDITIONS FOR IN-WATER WORK

2011

The permittee shall comply with the following conditions intended to protect manatees from direct project effects:

- a. All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.
- b. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.
- c. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.
- d. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.
- e. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida, and to FWC at ImperiledSpecies@myFWC.com
- f. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 ½" by 11" explaining the requirements for "Idle Speed/No Wake" and the shut down of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at MyFWC.com/manatee. Questions concerning these signs can be sent to the email address listed above.



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-0019

REPLY TO
ATTENTION OF

JAN 20 2017

Planning and Policy Division
Environmental Branch

Mr. David Bernhart
Assistant Regional Administrator
Protected Resources Division
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

Dear Mr. Bernhart:

In order to comply with Section 7 of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), the U.S. Army Corps of Engineers (Corps), Jacksonville District, respectfully requests a letter of concurrence from the National Marine Fisheries Service (NMFS) on the Lake Worth Lagoon Section 1135 Continuing Authorities Program (CAP) project. The proposed work is an ecosystem restoration project located in south central Florida in Palm Beach County. Restoration includes the creation of approximately 11 acres of small mangrove islands by filling dredge holes, placement of a thin layer of sand on muck sediment to create approximately 38 acres of seagrass habitat, and the placement of prefabricated reef modules for the creation of approximately 1 acre of oyster reef habitat.

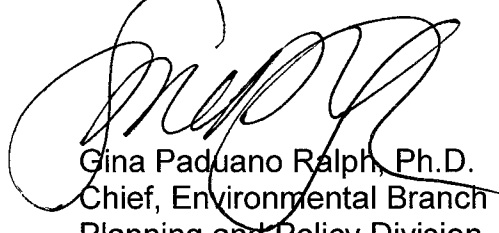
Included with this letter is additional information describing the proposed action, the action area, listed species and/or designated critical habitat (DCH) that may be affected by the action, and an analysis of the potential routes of effect on any listed species or DCH. The Corps has determined that the proposed project may affect, but is not likely to adversely affect, the following federally-listed species:

- Green sea turtle;
- Leatherback sea turtle;
- Loggerhead sea turtle;
- Hawksbill sea turtle;
- Smalltooth sawfish;
- Johnson's seagrass.

The Corps is requesting concurrence with our determinations pursuant to Section 7 of the ESA of 1973, as amended (16 U.S.C. § 1536), and the consultation procedures at

50 C.F.R. Part 402. The Corps appreciates your cooperation in completing this informal Section 7 consultation by concurring with the Corps' effect determination(s) within 30 days of the receipt of this letter. If NMFS disagrees with the Corps' effect determination(s) and requests formal Section 7 consultation, please contact the below referenced contact to discuss suggested modifications to the action to avoid potential adverse effects and NMFS' additional information needs. The Corps will continue to coordinate with NMFS office via email to provide the requested information and, if warranted, a revised effects determination. If you have any questions, or need additional information, please contact Kristen Scheler at (904) 232-2918 or email Kristen.L.Scheler@usace.army.mil. Thank you for your assistance.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch
Planning and Policy Division

Enclosure

Informal Section 7 Consultation for Lake Worth Lagoon Section 1135 Continuing Authorities Program (CAP) project

In order to comply with Section 7 of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), the U.S. Army Corps of Engineers (Corps), Jacksonville District, respectfully requests a letter of concurrence from the National Marine Fisheries Service (NMFS) on the Lake Worth Lagoon section 1135 Continuing Authorities Program (CAP) project. The proposed work is an ecosystem restoration project located in south central Florida in Palm Beach County. Restoration includes the creation of approximately 11 acres of small mangrove islands by filling dredge holes, placement of a thin layer of sand on muck sediment to create approximately 38 acres of seagrass habitat, and the placement of prefabricated reef modules for the creation of approximately 1 acre of oyster reef habitat.

The Corps has determined that the proposed project may affect but is not likely to adversely affect federally-listed species, as described in Table 1, and is therefore requesting concurrence with our determinations pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1536), and the consultation procedures at 50 C.F.R. Part 402.

Pursuant to our request for informal consultation, the Corps is providing the following information:

- A description of the action to be considered;
- A description of the action area;
- A description of any listed species or designated critical habitat (DCH) that may be affected by the action; and
- An analysis of the potential routes of effect on any listed species or DCH.

1. PROPOSED ACTION

a. Description of the proposed action:

The proposed action is to raise the existing bathymetry to the intertidal range and cover the existing muck material with clean sand. The project site is referred to as Bonefish Cove and is located in south Lake Worth Lagoon (see Figure 1). The goal of this alternative is to create three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of 2' x 3' pre-fabricated reef modules scattered around the islands. Fill material to be used for the project will be excavated and transported from Peanut Island Dredged Material Management Area (DMMA) – the same sediment source used for creating the Snook Islands and Grassy Flats. Peanut Island is 11.8 miles away from the Bonefish Cove site.

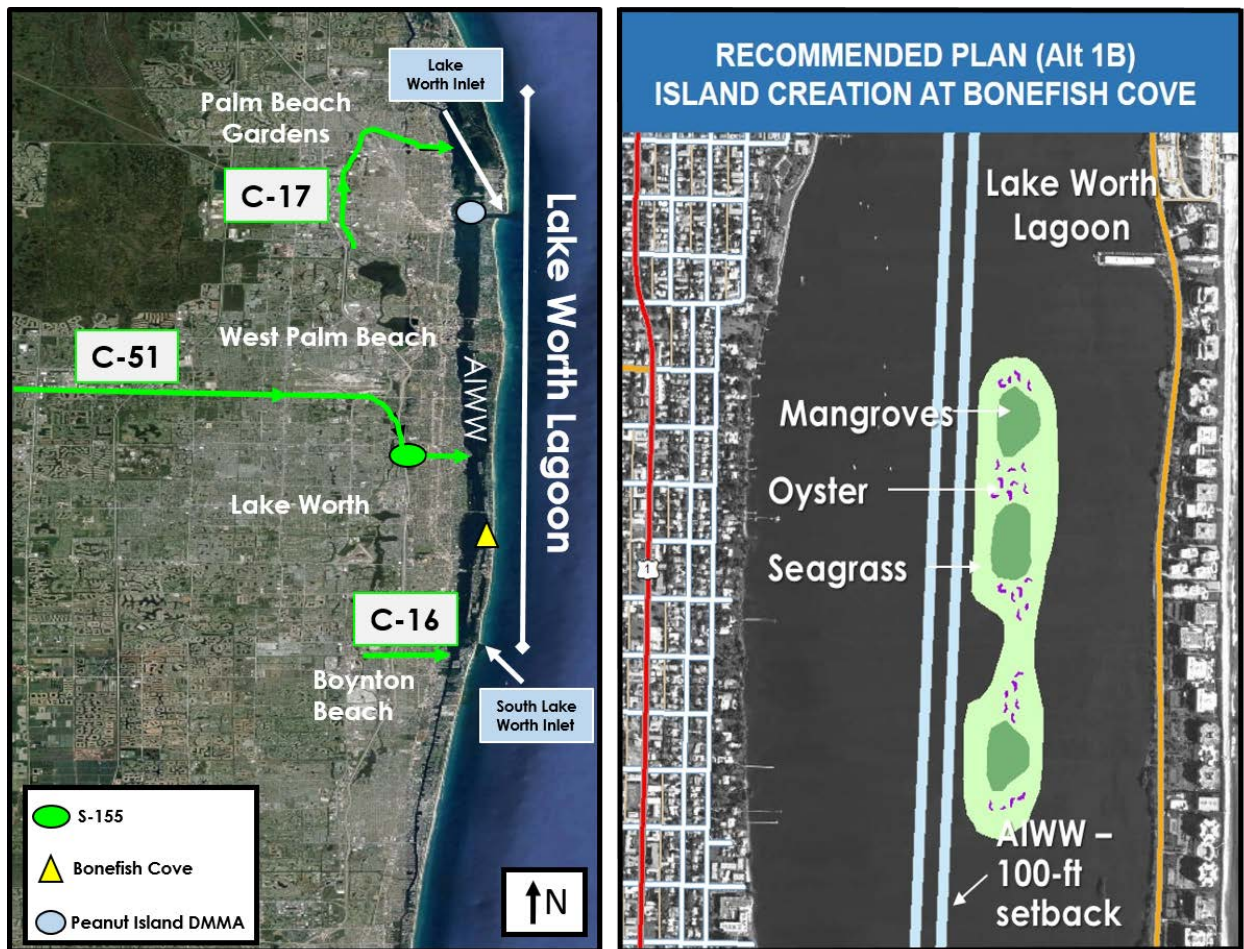


Figure 1. Action area and project location

The construction effort is tentatively scheduled to start in 2019 and take approximately 18 months to complete. Activities will consist of excavating approximately 345,000 cubic yards of fill material from Peanut Island via excavator and heavy earth movers to the Bonefish Cove site via barge to create three different substrate levels. The base or bed of the island will be raised to - 5.5 feet North American Vertical Datum of 1988 (NAVD88), which will be achieved on a 12.5% slope (1 foot vertical to 8 feet horizontal) from existing bathymetry and offset from the Intracoastal Waterway (IWW) right-of-way. The interior base of the island which is where the 2 feet by 3 feet pre-fabricated reef modules will be placed will be elevated to - 3.5 feet NAVD88 on a 4% slope (1 foot vertical to 25 feet horizontal), approximately one foot below mean low water (MLW), or - 2.5 feet NAVD88. To complete the island creation project, three mangrove islands will be established to - 0.5 feet NAVD88 on a 17% slope (1 foot vertical to 6 feet horizontal) (see Figure 2). In addition, the project would include the installation of riprap for shoreline protection and island stabilization. Riprap sizing is assumed to be similar to the type constructed at the Snook Islands and Grassy Flats projects (2 to 3 feet' limestone boulders). The post-construction features will include the creation of red mangrove habitat and installation of pre-fabricated reef modules for oyster reefs. Seagrass will not be planted because it is

anticipated the elevated substrates would provide enough benefit for natural seagrass recruitment.

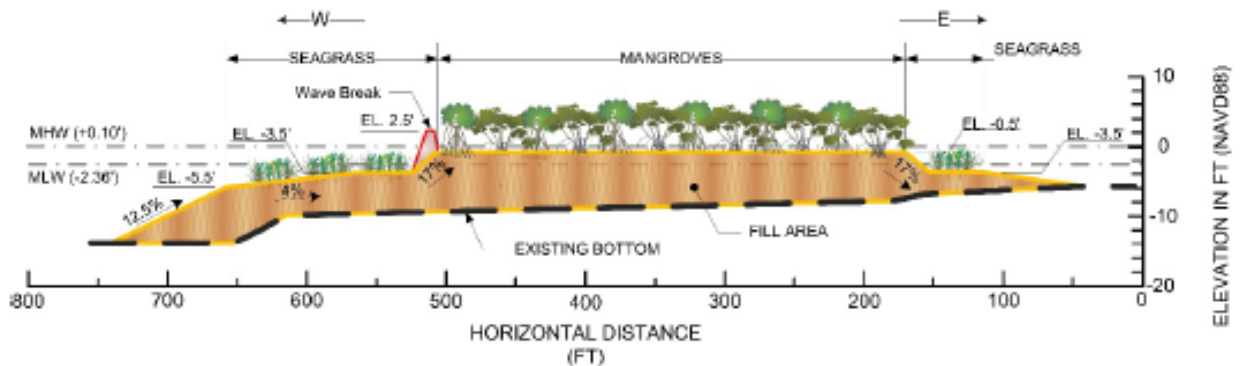


Figure 2. Project island creation cross section

b. Description of the project purpose:

Historic freshwater discharges into Lake Worth Lagoon sustained an ecologically appropriate range of salinity conditions and nutrient levels to facilitate the presence of healthy floral and faunal communities. As south Florida developed, the need to protect against flooding and support increased water supply for communities led to the construction of a canal network, part of the Central and Southern Florida Project. Although the canal network is efficient at reducing flood damages and meeting water supply needs, drastic salinity changes caused by freshwater pulses and contaminated runoff have degraded the biological integrity in Lake Worth Lagoon. The objective of the Lake Worth Lagoon Project is to improve the benthic habitat and marine ecosystem conditions of the lagoon within the limited authority of the CAP 1135 Program.

c. Description of minimization measures:

Applicable standard protective measures will be taken during in-water construction activities to ensure the safety of sea turtles in the project vicinity. These measures are recommended by NMFS and are described in the 2006 Sea Turtle and Smalltooth Sawfish Construction Conditions (see Attachment 1).

2. ACTION AREA

Pursuant to 50 C.F.R. § 402.02, the term *action area* is defined as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.” Accordingly, the action area typically includes the affected jurisdictional waters and other areas affected by the authorized work or structures within a reasonable distance.

For the purposes of this consultation, the action area for the project is Lake Worth Lagoon. Since sediment for the island creation will be sourced from Peanut Island DMMA, transit will occur between Peanut Island DMMA in north Lake Worth Lagoon and the Bonefish Cove project site in south Lake Worth Lagoon. Placement of fill material for the island

creation will create a temporary sediment plume. Best Management Practices (BMPs) and methods to manage placement of the capping/fill material will ensure minimized displacement of the muck sediment and controlled turbidity. Final details for BMPs and methods will be determined during the permitting and contracting process. The contractor will be given criteria to determine and achieve acceptable means and methods.

Lake Worth Lagoon is approximately 21 miles long and up to one mile wide. The lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Singer Island and Palm Beach Island. Although once a freshwater body, construction of the Lake Worth and South Lake Worth permanent inlets introduced mixing of fresh and salt waters at the northern and southern ends of the Lagoon. Depths typically range from 1 foot to 10 feet, though depths are much greater near the Port of Palm Beach and in locations where isolated holes are present from previous dredging activities (Lake Worth Lagoon Initiative, 2013). Natural sediment in Lake Worth Lagoon is comprised primarily of sand or shell fragments (Sea Diversified, Inc., 2010). However, deposition of fine-grained silt and clay-enriched organic “muck” sediments of greater than 1 foot in depth have been observed in over 42 locations in Lake Worth Lagoon (Lake Worth Lagoon Initiative, 2013). No corals, coral reefs, or hardbottoms are currently present in the project area. Over 250 species of fish have been documented in Lake Worth Lagoon (Palm Beach County Department of Environmental Resources Management, 2015). Seagrasses are present within the action area but not currently present in the project footprint. As of 2013, approximately 1,592 acres of seagrass beds were identified within Lake Worth Lagoon, a decrease from 1,688 acres identified in 2007 (Orlando et al., 2016). Multiple species of seagrass have been found in the Lagoon, including the threatened Johnson’s seagrass (*Halophila johnsonii*). Other species of seagrasses present may include manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), paddle grass (*Halophila decipiens*), and turtle grass (*Thalassia testudinum*).

3. AFFECTED SPECIES/HABITAT

Project activities have the potential to affect the listed species as shown in Table 1 below. Table 2 provides the species use of the action area.

Table 1: Species in the action area

Species	ESA Listing Status	Listing Rule/Date	Most Recent recovery plan date	USACE Effect Determination (Species)
Green sea turtle ¹	T	81 FR 20057/ April 6, 2016	October 1991	MANLAA
Leatherback sea turtle	E	35 FR 8491/ June 2, 1970	April 1992	MANLAA
Loggerhead sea turtle ²	T	76 FR 58868/ September 22, 2011	January 2009	MANLAA
Hawksbill sea turtle	E	35 FR 8491/ June 2, 1970	December 1993	MANLAA
Smalltooth sawfish ³	E	68 FR 15674/ April 1, 2003	January 2009	MANLAA
Johnson's seagrass	T	63 FR 49035/ September 14, 1998	October 2002	NLAA

Table 2: Species use of the Action Area

Species	Species Use of the Action Area and/or DCH Description
Green sea turtle	Foraging and transit, no DCH in action area
Leatherback sea turtle	Foraging and transit, no DCH in action area
Loggerhead sea turtle	Foraging and transit, no DCH in action area
Hawksbill sea turtle	Foraging and transit, no DCH in action area
Smalltooth sawfish	Rarely reported in SE Florida, foraging and transit
Johnson's seagrass	Present in action area, not present in project area DCH present in action area, no DCH present in project footprint

Sea Turtles

Within Lake Worth Lagoon, multiple species of turtles have been observed including the green sea turtle (*Chelonia mydas*), the loggerhead (*Caretta caretta*), the leatherback (*Dermochelys coriacea*), the hawksbill (*Eretmochelys imbricata*), and the Kemp's Ridley (*Lepidochelys kempii*). The lagoon is connected to nesting beaches and serves as an important developmental habitat for juvenile green sea turtles year round, which feed almost entirely on seagrasses. Because of their diet, green sea turtles concentrate in areas of healthy submerged aquatic vegetation where salinity levels are more constant. The green sea turtle population in Lake Worth Lagoon have a moderate prevalence of Fibropapillomatosis, which has been reported as stable or slightly increasing within the population (Palm Beach County Department of Environmental Resources Management, 2012). Other sea turtle species may use the lagoon for transit and foraging. There is no sea turtle DCH located in the action area, and since no sea grasses are currently located

¹ North Atlantic and South Atlantic DPS

² Northwest Atlantic Ocean DPS

³ U.S. DPS

in the project area, project activity is not anticipated to impact sea turtle foraging. Sea turtle usage of the site may be temporarily interrupted due to potential avoidance of construction activities. These species are highly mobile and can easily avoid the area, therefore, impacts are not anticipated to be significant. The project may beneficially affect sea turtles. Creation of seagrass habitat will increase the foraging habitat available to sea turtles in the lagoon. Applicable standard protective measures will be taken during in-water construction activities to ensure the safety of any sea turtles in the project vicinity. These measures are recommended by NMFS and are described in the 2006 Sea Turtle and Smalltooth Sawfish Construction Conditions (see Attachment 1).

Smalltooth sawfish

Smalltooth sawfish (*Pristis pectinata*) were once common in Florida as detailed by the “Smalltooth Sawfish Recovery Plan” (NMFS, 2009) and are rarely reported in southeast Florida. Their core range extends along the Everglades coast from the Ten Thousand Islands to Florida Bay, with moderate occurrences in the Florida Keys and at the mouth of the Caloosahatchee River. There is no smalltooth sawfish DCH located in the action area, and since sawfish are rarely encountered outside of the above listed areas (Simpfendorfer 2006), no adverse impacts to this species are anticipated. The project may beneficially affect smalltooth sawfish. Improved habitat in the lagoon could result in increased prey production and shelter for juveniles among the mangrove roots. Applicable standard protective measures will be taken during in-water construction activities to ensure the safety of any smalltooth sawfish in the project vicinity. These measures are recommended by NMFS and are described in the 2006 Sea Turtle and Smalltooth Sawfish Construction Conditions (see Attachment 1).

Johnson’s seagrass

Johnson’s seagrass (*Halophila johnsonii*), the only listed threatened marine plant species under the ESA, is found within Lake Worth Lagoon. Though Johnson’s seagrass is sensitive to turbidity, dissolved organic matter, and temperature, it is especially vulnerable to salinity fluctuations. Salinities of 30 parts per thousand (ppt) are required for optimal growth, however, Johnson’s seagrass is more tolerant of gradual salinity decreases and can survive for several weeks at salinities between 15-20 ppt. Data collected between 2010 to 2016 indicates there is an inverse relationship between freshwater discharge events and salinity levels in central Lake Worth Lagoon, with low salinity events (<10 ppt) occurring on an almost annual basis. No seagrasses or DCH is present in the project area, however, there are two sites of Johnson’s seagrass DCH located in the action area (see Figures 3 and 4). DCH Site 1 is located approximately 6.5 miles from Peanut Island DMMA and 5 miles from the Bonefish Cove project site. DCH Site 2 is located approximately 3 miles from the Bonefish Cove project site and approximately 15 miles from Peanut Island DMMA.

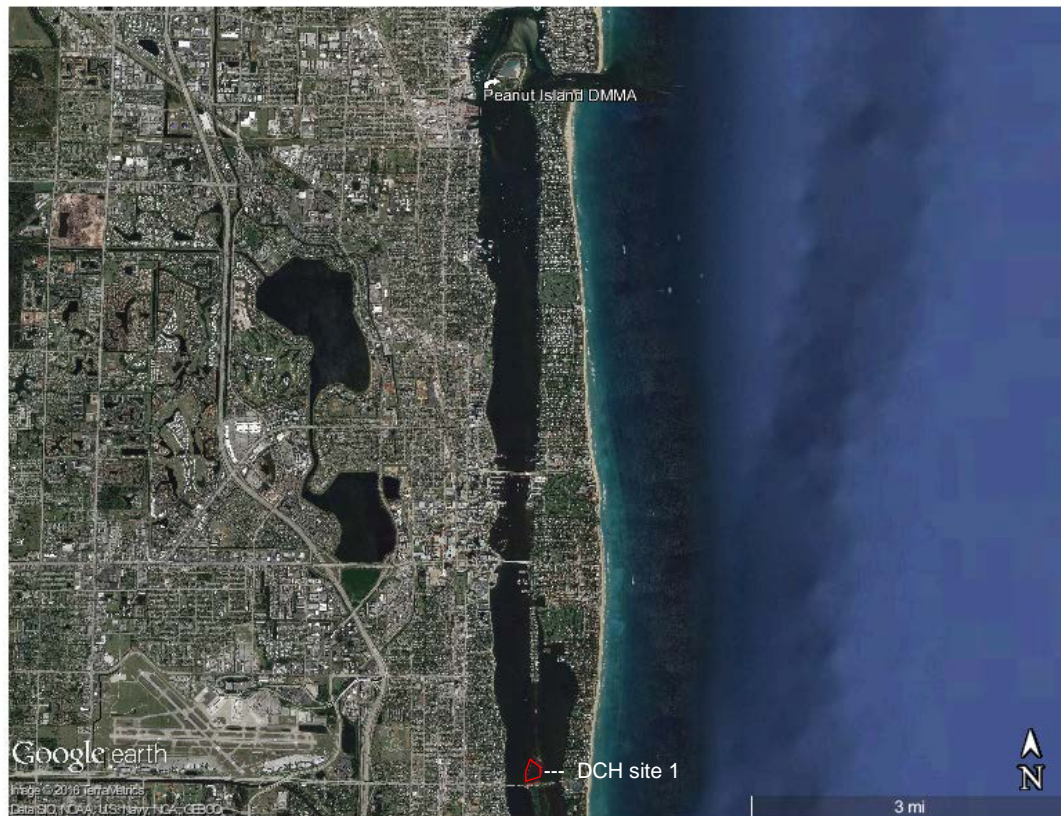


Figure 3. Johnson's seagrass DCH in Lake Worth Lagoon (north)

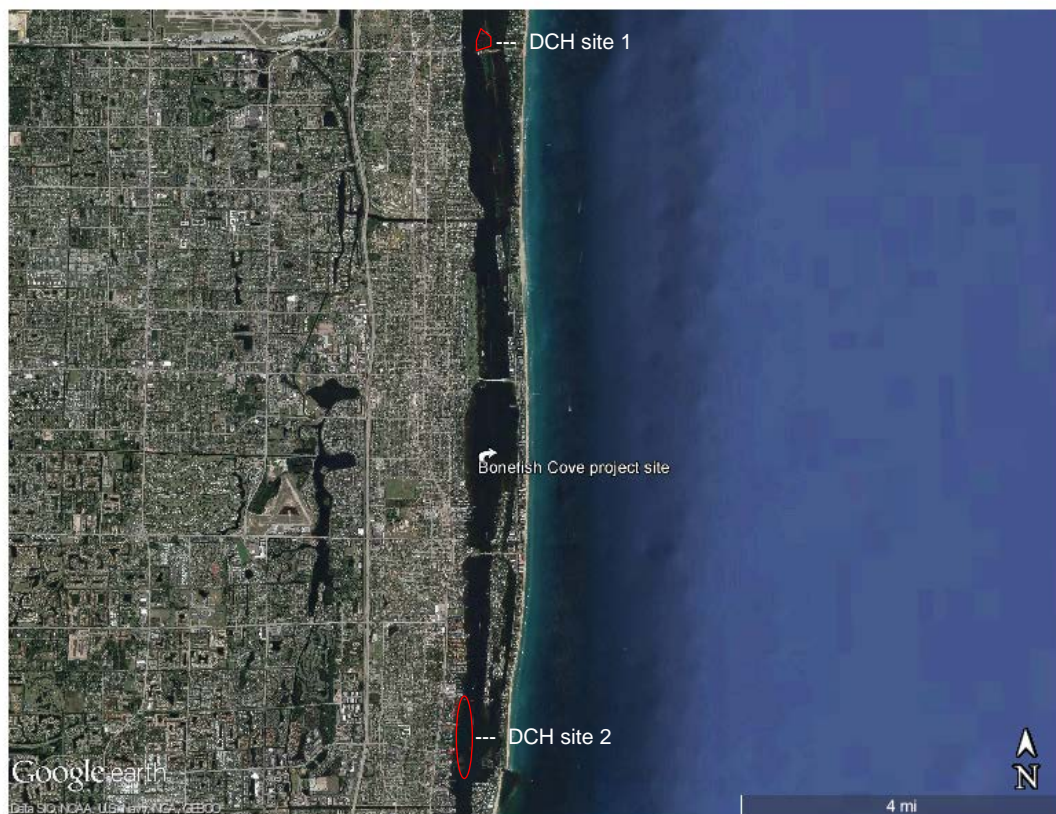


Figure 4. Johnson's seagrass DCH in Lake Worth Lagoon (south)

Placement of fill material may affect, but is not likely to adversely affect Johnson's seagrass within the action area. BMPs and methods to manage placement of the capping/fill material will ensure minimized displacement of the muck sediment and controlled turbidity. Final details for BMPs and methods will be determined during the permitting and contracting process. The contractor will be given criteria to determine and achieve acceptable means and methods. The project may beneficially affect Johnson's seagrass. Placement of fill material to create mangrove islands and viable seagrass habitat could result in natural recruitment of Johnson's seagrass to this area of the lagoon.

4. ROUTE(S) OF EFFECT TO SPECIES:

A temporary sediment plume will occur as a result of overboard placement of fill material to create the mangrove islands. Impacts will be temporary, lasting only as long as construction takes place. BMPs and methods to manage placement of the capping/fill material will ensure minimized displacement of the muck sediment and controlled turbidity. Conversion of the subtidal footprint will create suitable substrate that will encourage natural recruitment of Johnson's seagrass. Seagrass habitat will increase the foraging areas available to sea turtles

5. ROUTES OF EFFECT TO CRITICAL HABITAT

The project is not located in DCH. Although there is Johnson's seagrass DCH located in Lake Worth Lagoon, no potential routes of effect are anticipated to impact the DCH.

6. DETERMINATION:

The Corps has concluded the project may affect, but is not likely to adversely affect listed species in Table 1 and will not affect any DCH. This analysis was prepared based on the best scientific and commercial data available.

Literature Cited

- Lake Worth Lagoon Initiative, "Lake Worth Lagoon Management Plan," *Updated version of the Lake Worth Lagoon Management Plan*, 2013.
- National Marine Fisheries Services (NMFS). (2009). Recovery Plan for Smalltooth Sawfish (*Pristis pectinata*). Prepared by the Smalltooth Sawfish Recovery Team for the NMFS, Silver Spring, Maryland.
- Orlando, B., Anderson, E., & Yarbrow, L. (2016). "Seagrass Integrated Mapping and Monitoring Program Mapping and Monitoring Report No. 2."
- Palm Beach County Department of Environmental Resources Management. (2013). "2013 Lake Worth Lagoon Seagrass Habitat Map."
- Palm Beach County Department of Environmental Resources Management, "Assessment of Marine Turtles in the Lake Worth Lagoon-Phase III," *Report on work accomplished by Inwater Research Group*, 2012.
- Sea Diversified, Inc., "Muck/Sediment Thickness Study Lake Worth Lagoon, Palm Beach County, Florida," 2010.
- Simpfendorfer, C.A. (2006). Movement and habitat use of smalltooth sawfish. Final report. Mote Marine Laboratory Technical Report 1070. NOAA Purchase Order WC133F-04-SE-1543. January 2006.

Lake Worth Lagoon 1135 Continuing Authorities Program (CAP) Project

ATTACHMENT 1:

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

- a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.
- b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.
- c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.
- d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.
- e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.
- f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.
- g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

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Appendix D - Attachment 1:
404(b)(1) Evaluation

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Appendix B – Section 404(b)(1) Evaluation

I. PROJECT DESCRIPTION

a. Location. Lake Worth Lagoon (LWL) is located on the Atlantic Coast of Florida, within Palm Beach County as described in Section 1.3 of the LWL Integrated Feasibility Report and Environmental Assessment.

b. General Description. The plan consists of constructing a series of three upland islands for mangrove habitat at the Bonefish Cove project site that will be protected with riprap. Creation of the mangrove islands will also provide for shallow seagrass recruitment areas and oyster reefs. The construction effort will consist of transporting approximately 345,000 cubic yards of fill material from Peanut Island Dredged Material Management Area (DMMA) to the Bonefish Cove project site to create three different substrate levels. The base or bed of the island will be raised to - 5.5 feet NAVD88, which will be achieved on a 1:8 slope. The interior base of the island will be elevated to - 3.5 feet NAVD88 on a 1:25 slope, approximately one foot below mean low water (MLW), or - 2.5 feet NAVD88. To complete the island creation, three mangrove islands will be established to -0.5 feet NAVD88 on a 1:6 slope. The project also includes the installation of riprap at the toe for shoreline protection and island stabilization. The post-construction features will include planting of mangroves on the constructed islands and installation of Bay Balls for oyster reefs on the interior base. Due to the elevated substrates, natural recruitment of seagrasses is anticipated.

c. Authority and Purpose. See section 1.1 of the associated project report. This will enhance benthic environment, create nursery area for fish, crustaceans and shell fish.

d. General Description of Dredged Material

(1) General Characteristics of Material: The project material is comprised of mainly sand, with some silt and rock material. Material is low in fines and is being obtained from the Peanut Island DMMA.

(2) Quantity of Material: It is estimated that 345,000 cubic yards of material will be removed from the DMMA and placed in the project site.

(3) Source of Material: Material from Peanut Island DMMA.

e. Description of the Proposed Discharge Site(s)

(1) Location. Dredged material from Peanut Island DMMA will be placed in the Bonefish Cove project site.

(2) Size. Approximately 50 acre eco-island chain.

(3) Type of Site. Intertidal/sub-tidal area.

(4) Type(s) of Habitat. Lagoon placement area is heavily impacted by runoff sediments, which has covered the sandy substrate with high organic mucky sediments. Borrow holes previously dredged for borrow material will be sites for fill placement as well. Existing conditions are not suitable for oyster habitat or seagrass/mangrove recruitment.

(5) Timing and Duration of Discharge. The exact timing of fill placement operations is not known, as the means and methods are not defined.

f. Description of fill placement method. Exact method to be determined during design and industry day with potential bidders to best manage displacement of muck in an economically sound manner.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope: The base or bed of the island will be raised to - 5.5 feet NAVD88, which will be achieved on a 1:8 slope. The interior base of the island will be elevated to - 3.5 feet NAVD88 on a 1:25 slope, approximately one foot below mean low water (MLW), or - 2.5 feet NAVD88. To complete the island creation, three mangrove islands will be established to -0.5 feet NAVD88 on a 1:6 slope. The project also includes the installation of riprap at the toe for shoreline protection and island stabilization.

(2) Sediment Type. The material to be placed in the project area will be material from the peanut island DMMA. This material consists primarily of sand with low fines content with some clay silt and rocky material.

(3) Dredged Material Movement: Material will settle and remain within boundaries of upland site or be moved to downdrift beaches by wave action if placed in nearshore or beach placement.

(4) Physical Effects on Benthos: Some benthic organisms that are not mobile may be covered by the fill material. Recolonization soon after project completion is expected to replace those organisms that do not survive project construction. It is anticipated that no long-term adverse impacts will occur. It is expected the capping of the high organic content mucky sediments will provide improved habitat for benthic organisms and reduce reflux of nutrients into the water column.

(5) Other Effects: Not applicable.

(6) Actions Taken to Minimize Impacts: Best Management Practices (BMPs) and methods to manage placement of the capping/fill material will need to ensure displacement of the mucky high organic content sediments is minimized and turbidity is controlled. Methods are being coordinated with the resource agencies. Final details for controlling muck displacement and turbidity will be determined during the permitting and contracting process. Contractor will be given criteria to achieve and contractor will determine means and methods.

b. Water Circulation. Fluctuation and Salinity Determinations

(1) Water column: During nearshore placement operations, turbidity will increase temporarily in the water column adjacent to the project. The increased turbidity will be short-term; therefore nearshore placement will have no long-term or significant impacts, if any, on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients or eutrophication.

(2) Current Patterns and Circulation: Currents in the LWL are influenced primarily by tides moving through two inlets, Lake Worth Inlet and South Lake Worth (Boynton) Inlet which connect the lagoon to the Atlantic Ocean. The project will have no significant effect on existing current patterns, current flow, velocity, stratification, or the hydrologic regime in the area.

(3) Normal Water Level Fluctuations: LWL water level is influenced by episodic freshwater flows and tides. This project will have no significant effect on existing water level fluctuations.

(4) Salinity Gradients: Salinity is that of oceanic water. Dredged material placement will not affect normal tide fluctuations or salinity.

(5) Actions That Will Be Taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

c. Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Placement Site: There may be a temporary increase in turbidity levels in the project area along the placement site during discharge. Turbidity will be short-term and localized and no significant adverse impacts are expected. State water quality standards for turbidity outside an allowable mixing zone would not be exceeded.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column: The lagoon, at this location, is characterized by mucky/high organic content sediments. There would be little, if any, adverse effects to chemical and physical properties of the water as a result of placing low fines content dredged material in the project area.

(a) Light Penetration: Some decrease in light penetration may occur in the immediate vicinity of the project area. This effect will be temporary, limited to the immediate area of construction, and will have no adverse impact on the environment.

(b) Dissolved Oxygen: It is likely that the capping of the high organic content muck with the capping material will reduce biological oxygen demand.

(c) Toxic Metals and Organics: No toxic metals or organics are expected to be released by the project. Some organics from the mucky/high organic content sediment will be brought temporarily into the water column in the immediate project area during capping material placement, but that will be limited by construction methods.

(d) Pathogens: No pathogens are expected to be released by the project.

(e) Aesthetics: The aesthetic quality of the water in the immediate area of the project will be reduced during construction due to increased turbidity. This will be a short-term and localized condition. The placement of the muck capping material will likely improve the aesthetic and habitat area quality of the project area.

(f) Others as Appropriate: None.

(3) Effects on Biota

(a) Primary Production, Photosynthesis: Primary productivity will be temporarily decreased during capping material placement where a temporarily increased level of suspended particulates will occur.

(b) Suspension/Filter Feeders: An increase in turbidity could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity will have any long-term negative impact on these highly fecund organisms.

(c) Sight Feeders: No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

(4) Actions taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

d. Contaminant Determinations: The material that will be disposed will not introduce, relocate, or increase contaminants at the area. The material would be clean low fine material sand with some clays and rocky materials. This capping material has been used for two other environmental restoration projects. The Florida Department of

Environmental Protection (FDEP), the Environmental Protection Agency (EPA) delegated authority for water quality, will review the local sponsor's application and issue a permit for this activity. It is expected that the past history of the fill source will provide sufficient reasonable assurance to the FDEP, but FDEP makes the final determination as to what provides reasonable assurance.

e. Aquatic Ecosystem and Organism Determinations: The material that will be placed in the project area consist of sand with low fines content, with some clays and rocky material that will be used to cap high organic content mucky sediments. Capping of this urban/agricultural runoff material is expected to enhance water quality and the aquatic ecosystem habitat.

(1) Effects on Plankton: No adverse impacts on autotrophic or heterotrophic during fill placement due to elevated turbidity. Long term, the turbidity and biological oxygen demand resulting from the capping of the mucky/high organic content sediments is expected to be reduced which will should not negatively impact plankton productivity.

(2) Effects on Benthos: The material will bury some benthic organisms. Recolonization is expected to occur within a year after construction activities cease. No adverse long-term impacts to non-motile or motile benthic invertebrates are anticipated.

(3) Effects on Nekton: No adverse impacts to nektonic species are anticipated.

(4) Effects on Aquatic Food Web: No adverse long-term impact to any trophic group in the food web is anticipated. Mangrove forests contribute to the overall health of the state's southern coastal zone. This ecosystem traps and cycles various organic materials, chemical elements, and important nutrients. Mangrove roots act not only as physical traps but provide attachment surfaces for various marine organisms. Many of these attached organisms filter water through their bodies and, in turn, trap and cycle nutrients. Mangroves provide protected nursery areas for fishes, crustaceans, and shellfish.

(5) Effects on Special Aquatic Sites: There are no hardground or coral reef communities located in the immediate project area that would be impacted by placement activities. Section 2.4 of the project's report offers a more detailed discussion on impacts.

(6) Threatened and Endangered Species: Appropriate measures to avoid, minimize, and mitigate for impacts to listed species are currently being coordinated with the US Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS).

(7) Other Wildlife: No adverse impacts to small foraging mammals, reptiles, or wading birds, or wildlife in general are expected. Many animals find shelter

either in the roots or branches of mangroves, which will be planted as part of the project. Mangrove branches are rookeries, or nesting areas, for coastal birds such as brown pelicans and roseate spoonbills

(8) Actions to Minimize Impacts: BMPs along with terms and conditions associated with Endangered Species Act (ESA) Biological Opinions will be followed.

f. Proposed Placement Site Determinations

(1) Mixing Zone Determination: Clean fill material, consisting primarily of sand with low fines with some clays and rocky material would be placed in the project area. This will not cause unacceptable changes in the mixing zone water quality requirements as specified by the State of Florida's Water Quality Certification permit procedures. No adverse impacts related to depth, current velocity, direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents are expected from implementation of the project.

(2) Determination of Compliance with Applicable Water Quality Standards: Because of the inert nature of the material to be disposed, Class III water quality standards will not be violated.

(3) Potential Effects on Human Use Characteristic

(a) Municipal and Private Water Supply: No municipal or private water supplies will be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries: Fishing in the immediate construction area will be prohibited during construction. Otherwise, recreational and commercial fisheries will not be impacted by the implementation of the project. Based on two other restoration projects using the same fill material to cap the high organic content muck/sediment, recreational game fishing will be enhanced. Mangroves provide protected nursery areas for fishes, crustaceans, and shellfish. They also provide food for a multitude of marine species such as snook, snapper, tarpon, jack, sheepshead, red drum, oyster, and shrimp.

(c) Water Related Recreation: Water related recreation in the immediate vicinity of construction will be prohibited during construction activities. This will be a short-term impact.

(d) Aesthetics: The existing environmental setting will not be adversely impacted. Construction activities will cause a temporary increase in noise and air pollution caused by equipment as well as some temporary increase in turbidity. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions will return to pre-project

levels.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves: No such designated sites are located within the project area.

g. Determination of Cumulative Effects on the Aquatic Ecosystem: There will be no cumulative impacts that result in a major impairment in water quality of the existing aquatic ecosystem resulting from the placement of material at the project site. Creation of seagrass beds and mangrove forest will benefit the aquatic ecosystem.

h. Determination of Secondary Effects on the Aquatic Ecosystem: There will be no negative secondary impacts on the aquatic ecosystem as a result of the fill placement or creation of seagrass bed habitat and mangrove forests.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation: No significant adaptations of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem: No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States. Further, no less environmentally damaging practical alternatives to the proposed actions exist. It is expected that the placement of this fill will improve aquatic habitat by capping high organic content sediment resulting from uncontrolled runoff from urban and agricultural areas. Creation of the mangrove and seagrass habitat will provide an enhanced habitat for juvenile fish and crustaceans. In addition, the impacts of using other sources on cultural resources, protected species, and other environmental factors would likely be equal to or greater than the impacts of the proposed action. The no action alternative would maintain the present condition of the poor quality benthic habitat created by the runoff of high organic content sediments which capped the previously existing sandy bottom, would also maintain the low productivity deep hole created by borrow material dredging nor would it allow the shoreline stabilization afford by mangrove recruitment.

c. Compliance with Applicable State Water Quality Standards: After consideration of placement site dilution and dispersion, the discharge of dredged materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition: Under Section 307 Of the Clean Water Act: The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. Compliance with Endangered Species Act of 1973: The placement of dredged

material will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the ESA of 1973, as amended. Standard conditions for monitoring and relocating turtle nests would be employed.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972: No marine sanctuaries are located within the project area.

g. Evaluation of Extent of Degradation of the Waters of the United States: The placement of dredged material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem: Appropriate steps have been taken to minimize the adverse environmental impact of the proposed action. The material proposed as beach has low silt content, therefore, turbidity due to silt will be low when discharging. Turbidity will be monitored so that if levels exceed State water quality standards of 29 nephelometric turbidity units (NTUs) above background, the contractor will be required to cease work until conditions return to normal. In the vicinity of reef and other hard grounds, measures would be taken to minimize sediment deposition on sensitive organisms.

i. On the basis of the guidelines, the proposed alternative is specified as complying with the requirements of these guidelines.

Appendix D - Attachment 2:
Coastal Zone Management Act (CZMA)
Federal Consistency Determination (FCD)

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Scheler, Kristen L CIV USARMY CESAJ (US)

From: Stahl, Chris <Chris.Stahl@dep.state.fl.us>
Sent: Monday, April 10, 2017 2:23 PM
To: Scheler, Kristen L CIV USARMY CESAJ (US)
Subject: [Non-DoD Source] State_Clearance_Letter_For_FL201702287919C-DIFR&EA for Lake Worth Lagoon 1135 Continuing Authorities Program, Palm Beach County,

April 10, 2017

Kristen Scheler
US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

RE: Department of the Army, Jacksonville District Corps of Engineers - Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA) for Lake Worth Lagoon 1135 Continuing Authorities Program (CAP), Palm Beach County, Florida.
SAI # FL201702287919C

Dear Kristen:

Florida State Clearinghouse staff has reviewed the proposal under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

We note that two cultural resources are recorded in or near the proposed project area: Historic structure 8PB10952, Peanut Island Coast Guard Station, and resource group 8PB06291, Peanut Island US Coast Guard Station, and both have been determined as eligible for the National Register. However, it is the opinion of the Division of Historical Resources & State Historic Preservation Officer that the project will have no adverse effects. If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes. If you have any questions, please contact Alyssa Costas, Historic Sites Specialist, by email at Alyssa.Costas@dos.myflorida.com, or by telephone at 850.245.6333 or 800.847.7278.

Based on the information submitted and minimal project impacts, the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes.

Thank you for the opportunity to review the proposed plan. If you have any questions or need further assistance, please don't hesitate to contact me at (850) 717-9076.

Sincerely,

Chris Stahl

Chris Stahl, Coordinator
Florida State Clearinghouse
Florida Department of Environmental Protection
2600 Blair Stone Road, M.S. 47
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ph. (850) 717-9076
State.Clearinghouse@dep.state.fl.us



**FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES**

LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 1135 PROJECT

1. Chapter 161, Beach and Shore Preservation. The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Response: The proposed plans and information will be submitted to the State in compliance with this chapter.

2. Chapters 186 and 187, State and Regional Planning. These chapters establish the State Comprehensive Plan which sets goals that articulate a strategic vision of the State's future. Its purpose is to define in a broad sense, goals, and policies that provide decision-makers directions for the future and provide long-range guidance for an orderly social, economic and physical growth.

Response: The proposed project shall be coordinated with various Federal, State and local agencies during the planning process. The project meets the primary goal of the State Comprehensive Plan through preservation and protection of the shorefront development and infrastructure.

3. Chapter 252, Disaster Preparation, Response and Mitigation. This chapter creates a state emergency management agency, with the authority to provide for the common defense; to protect the public peace, health and safety; and to preserve the lives and property of the people of Florida.

Response: The proposed project will not impact the public peace, health and safety. Therefore, this project would be consistent with the efforts of Division of Emergency Management.

4. Chapter 253, State Lands. This chapter governs the management of submerged state lands and resources within state lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

Response: The proposed project shall be coordinated with various Federal, State and local agencies during the planning process. All proposed work would avoid or minimize impacts to resources within submerged state lands. Appropriate protective measures shall be

implemented where necessary. The proposed project would comply with the intent of this chapter.

5. Chapters 253, 259, 260, and 375, Land Acquisition. This chapter authorizes the state to acquire land to protect environmentally sensitive areas.

Response: No land acquisition is proposed in this project.

6. Chapter 258, State Parks and Aquatic Preserves. This chapter authorizes the state to manage state parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs, management or operations.

Response: There are no state parks or preserves that occur within or along the project area.

7. Chapter 267, Historic Preservation. This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

Response: No significant impacts to historical properties are expected from construction of the proposed project based upon the results of site investigations and this coordination.

8. Chapter 288, Economic Development and Tourism. This chapter directs the state to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

Response: The proposed work would not affect tourism. Therefore, the project is consistent with the goals of this chapter.

9. Chapters 334 and 339, Public Transportation. This chapter authorizes the planning and development of a safe balanced and efficient transportation system.

Response: No public transportation systems would be impacted by this project.

10. Chapter 370, Saltwater Living Resources. This chapter directs the state to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in state waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the state engaged in the taking of such resources within or without state waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and, to conduct scientific, economic, and other studies and research.

Response: The proposed project is expected to have temporary or minimal impacts to saltwater living resources during construction. The proposed project will have positive long term impacts to saltwater living resources due to the creation of seagrass, oyster, and mangrove habitat and improved water quality from the capping of muck sediments via the creation of the mangrove islands. Appropriate projection measures shall be implemented where necessary.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

Response: The project is expected to have no significant effect on freshwater aquatic life or wild animal life.

12. Chapter 373, Water Resources. This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

Response: This project does not involve water resources as described by this chapter.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and will require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. A spill prevention plan will be required.

14. Chapter 377, Oil and Gas Exploration and Production. This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

Response: This project does not involve the exploration, drilling or production of gas, oil or petroleum product and therefore, this chapter does not apply.

15. Chapter 380, Environmental Land and Water Management. This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact nature of proposed large-scale development.

Response: The proposed project may have positive long term regional impacts due to the creation of seagrass, oyster, and mangrove habitat and improved water quality from the capping of muck sediments via the creation of the mangrove islands. The project is consistent with the goals of this chapter.

16. Chapter 388, Arthropod Control. This chapter provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the state.

Response: The project will not further the propagation of mosquitoes or other pest arthropods.

17. Chapter 403, Environmental Control. This chapter authorizes the regulation of pollution of the air and waters of the state by the Florida Department of Environmental Regulation (now a part of the Florida Department of Environmental Protection).

Response: Environmental protection measures will be implemented to ensure that no lasting adverse effects on water quality, air quality, or other environmental resources will occur. Coordination with the Florida Department of Environmental Protection shall occur prior to construction. The project complies with the intent of this chapter.

18. Chapter 582, Soil and Water Conservation. This chapter establishes policy for the conservation of the state soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the project. Particular attention will be given to projects on or near agricultural lands.

Response: The proposed project is not expected to occur near or on agricultural lands; therefore, this chapter does not apply.

Appendix D – Attachment 3:
Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) Project
Distribution List

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FEDERAL AGENCIES

Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, DC 20001-2637

Office of the Director
Center for Environmental Health
4770 Buford Hwy
Atlanta, GA 30341

Director, Office of Environmental Policy and Compliance
U.S. Department of the Interior
1849 C St NW (MS2462)
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Mr. Dennis Roberts, Regional Administrator
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PO Box 20636
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Regional Director, Ins & Mitigation Div
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Florida Division
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Director
Federal Maritime Commission
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National Center for Environmental Health
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National Park Service
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US Department of Housing & Urban Development
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South Florida Ecological Services Office
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Mr. Armando Ramirez
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Ms. Susan Gray, Chief Environmental Scientist
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Lake Worth, FL 33460

Michael Bornstein, City Manager
City of Lake Worth
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Lake Worth, FL 33460

Gail L. Coniglio, Mayor
Town of Palm Beach
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Palm Beach, FL 33480

Thomas G. Bradford, Town Manager
Town of Palm Beach
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Palm Beach, FL 33480

Carl Baker, Director of Planning & Development
Port of Palm Beach
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Wayne M. Richards, Commissioner
Port of Palm Beach
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Mark Crosley, Executive Director
Florida Inland Navigation District
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Charles Isiminger, Palm Beach County Commissioner
Florida Inland Navigation District
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Jupiter, FL 33477

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Everglades Coordinating Council
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300 Aragon Avenue Suite 360
Coral Gables, FL 33134

Tropical Audubon Society Inc.
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Miami, FL 33143

Appendix D – Environmental
Attachment 4: Cultural Resources and Native American Resources Consultation
Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) Project

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FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Dr. Gina Paduano Ralph
Chief, Environmental Branch, Planning and Policy Division
Jacksonville District Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

June 2, 2017

RE: DHR Project File No.: 2016-3626-B, Received by DHR: May 4, 2017
Phase I Submerged Cultural Resource Remote Sensing Survey of a Proposed Restoration Site at Bonefish Cove in Lake Worth Lagoon, Palm Beach County, Florida

Dear Dr. Paduano Ralph:

Our office received and reviewed the above referenced report for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places*. The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*.

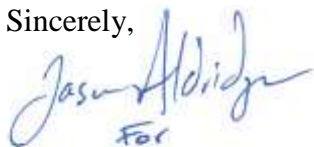
In September 2016, Tidewater Atlantic Research, Inc. (TAR) conducted a Phase I submerged cultural resource assessment survey (CRAS) of approximately 159 acres of Lake Worth bottomland on behalf of CB&I Coastal Planning & Engineering (CB&I). TAR utilized magnetic and acoustic remote sensing equipment to document potential cultural resources within the area of potential effect (APE). TAR documented two clusters of anomalies that represent potential cultural material and recommended avoidance of these targets in addition to a 150-foot radii buffer zone around each cluster. TAR also documented one area with sunken vessel remains and recommended avoidance and a 200-foot radius buffer around the remains. If avoidance is not feasibly, TAR recommends additional investigation of the three buffer zones to confirm the nature of the anomalies and assess their significance in regards to NRHP eligibility.

The U.S. Army Corps of Engineers (Corps) concurs with TAR's recommendations; however, they increased the three buffer zones to have a 200-foot radius each where no dredging, anchoring, or spudding will be permitted. Based on this information, the Corps determined that this project will have no effect on historic properties eligible for inclusion in the NRHP.

Based on the information provided, our office concurs with the Corps determination and finds the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code*; however, DHR requests the submission of Florida Master Site File forms and maps in color hard copy and digital format. Please request the consultant or applicant submit digital copies of the FMSF Survey Log, a map, and this CRAS report to complete this review. The preferred method is via CD or jump drive, but in this instance I can receive said documents via the below email.

If I can be of any further help, or if you have any questions about this letter, please feel free to contact Lindsay Rothrock at Lindsay.Rothrock@dos.myflorida.com.

Sincerely,

A handwritten signature in blue ink that reads "Jason Aldridge" with the word "For" written below it.

Timothy A. Parsons, Ph.D., RPA
Director, Division of Historical Resources
and State Historic Preservation Officer



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

MAY 03 2017

Mr. Paul Backhouse, THPO
Seminole Tribe of Florida
Tribe Historic Preservation Office
30290 Josie Billie Highway
PMP 1004
Clewiston, FL 33440

Lake Worth Lagoon Project:

Dear Mr. Backhouse:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with proposed modifications to the Bonefish Cove project area in Lake Worth Lagoon, Palm Beach County, Florida. The project was authorized for improving the quality of the environment under the Continuing Authorities Program (CAP), Section 1135. Palm Beach County is the non-federal sponsor. The restoration activities involve the creation of three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of Bay Balls scattered around the islands.

Palm Beach County contracted CB&I Coastal Planning & Engineering, Inc. (CB&I) to conduct a submerged cultural resources remote sensing survey of the Bonefish Cove project area. Archaeological personnel from Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina were contracted by CB&I to provide onboard supervision of the survey, analysis of the data, and production of a cultural resources report for CB&I. The draft report entitled: *Phase 1 Submerged Cultural Resource Remote Sensing Survey of a Proposed Restoration Site at Bonefish Cove in Lake Worth Lagoon Palm beach County, Florida* is enclosed with this letter.

TAR conducted the remote sensing survey of the Bonefish Cove project area on 22 and 23 September, 2016 to locate and identify any magnetic anomalies and/or acoustic targets that could be associated with historic vessel remains or other potentially significant submerged cultural resources. Data were collected along 17 survey transects spaced at 30-meter intervals utilizing a cesium vapor magnetometer, dual-frequency digital side-scan sonar, and chirp sub-bottom profiler.

TAR's survey resulted in the identification of 96 anomalies. Six of these anomalies identified in three clusters have signature characteristics considered to be associated with significant submerged cultural resources. TAR has recommended buffer radii of 150 feet for two of the clusters, and a buffer radius of 100 feet for remaining cluster to avoid adverse impacts to these three clusters of potentially significant resources, or additional diver identification surveys to assess their significance for inclusion in the National Register of Historic Places (NRHP). TAR has assessed the remaining 90 anomalies to be associated with insignificant dredge spoil material, riprap, or cables. In addition, no evidence of relict landforms associated with patterns of prehistoric activity were identified during the survey.

As a result of these investigations and to ensure protection of potentially significant submerged cultural resources, the Corps will buffer these three clusters with a buffer radius of 200 feet where no dredging, anchoring, or spudding will be permitted. Based on this information, the Corps has determined project activities occurring within the surveyed area will pose no effect to historic properties eligible for inclusion in the NRHP. Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470) and its implementing regulations (36 CFR 800), I request your comments on the determination of no effect for project activities within the surveyed area, and your comments on the draft report. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures

Dinkens/CESAJ-PD-E
Tiemann/CESAJ-PD-ES
Moreno/CESAJ-PD-ES
LoSchiavo/CESAJ-PD-ES
Ralph/CESAJ-PD-E



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

MAY 03 2017

Tim Parsons, Ph.D.
Division of Historical Resources
State Historic Preservation Officer
500 South Bronough Street
Tallahassee, Florida 32399-0250

Re: Lake Worth Lagoon Feasibility Study, Palm Beach County, Florida

Dear Dr. Parsons:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with proposed modifications to the Bonefish Cove project area in Lake Worth Lagoon, Palm Beach County, Florida. The project was authorized for improving the quality of the environment under the Continuing Authorities Program (CAP), Section 1135. Palm Beach County is the non-federal sponsor. The restoration activities involve the creation of three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of Bay Balls scattered around the islands.

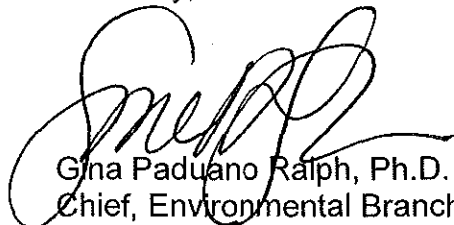
Palm Beach County contracted CB&I Coastal Planning & Engineering, Inc. (CB&I) to conduct a submerged cultural resources remote sensing survey of the Bonefish Cove project area. Archaeological personnel from Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina were contracted by CB&I to provide onboard supervision of the survey, analysis of the data, and production of a cultural resources report for CB&I. The draft report entitled: *Phase 1 Submerged Cultural Resource Remote Sensing Survey of a Proposed Restoration Site at Bonefish Cove in Lake Worth Lagoon Palm beach County, Florida* is enclosed with this letter.

TAR conducted the remote sensing survey of the Bonefish Cove project area on 22 and 23 September, 2016 to locate and identify any magnetic anomalies and/or acoustic targets that could be associated with historic vessel remains or other potentially significant submerged cultural resources. Data were collected along 17 survey transects spaced at 30-meter intervals utilizing a cesium vapor magnetometer, dual-frequency digital side-scan sonar, and chirp sub-bottom profiler.

TAR's survey resulted in the identification of 96 anomalies. Six of these anomalies identified in three clusters have signature characteristics considered to be associated with significant submerged cultural resources. TAR has recommended buffer radii of 150 feet for two of the clusters, and a buffer radius of 100 feet for remaining cluster to avoid adverse impacts to these three clusters of potentially significant resources, or additional diver identification surveys to assess their significance for inclusion in the National Register of Historic Places (NRHP). TAR has assessed the remaining 90 anomalies to be associated with insignificant dredge spoil material, riprap, or cables. In addition, no evidence of relict landforms associated with patterns of prehistoric activity were identified during the survey.

As a result of these investigations and to ensure protection of potentially significant submerged cultural resources, the Corps will buffer these three clusters with a buffer radius of 200 feet where no dredging, anchoring, or spudding will be permitted. Based on this information, the Corps has determined project activities occurring within the surveyed area will pose no effect to historic properties eligible for inclusion in the NRHP. Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470) and it's implementing regulations (36 CFR 800), I request your comments on the determination of no effect for project activities within the surveyed area, and your comments on the draft report. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

MAY 03 2017

Mr. Fred Dayhoff, Tribal Representative
NAGPRA, Section 106
Miccosukee Tribe of Indians of Florida
HC 61 SR68
Ochopee, Florida 34141

Lake Worth Lagoon Project:

Dear Mr. Dayhoff:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with proposed modifications to the Bonefish Cove project area in Lake Worth Lagoon, Palm Beach County, Florida. The project was authorized for improving the quality of the environment under the Continuing Authorities Program (CAP), Section 1135. Palm Beach County is the non-federal sponsor. The restoration activities involve the creation of three upland islands for mangrove habitat that will be protected with rip rap and interment oyster reefs in the form of Bay Balls scattered around the islands.

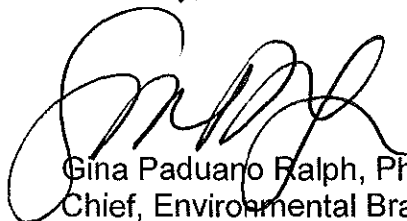
Palm Beach County contracted CB&I Coastal Planning & Engineering, Inc. (CB&I) to conduct a submerged cultural resources remote sensing survey of the Bonefish Cove project area. Archaeological personnel from Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina were contracted by CB&I to provide onboard supervision of the survey, analysis of the data, and production of a cultural resources report for CB&I. The draft report entitled: *Phase 1 Submerged Cultural Resource Remote Sensing Survey of a Proposed Restoration Site at Bonefish Cove in Lake Worth Lagoon Palm beach County, Florida* is enclosed with this letter.

TAR conducted the remote sensing survey of the Bonefish Cove project area on 22 and 23 September, 2016 to locate and identify any magnetic anomalies and/or acoustic targets that could be associated with historic vessel remains or other potentially significant submerged cultural resources. Data were collected along 17 survey transects spaced at 30-meter intervals utilizing a cesium vapor magnetometer, dual-frequency digital side-scan sonar, and chirp sub-bottom profiler.

TAR's survey resulted in the identification of 96 anomalies. Six of these anomalies identified in three clusters have signature characteristics considered to be associated with significant submerged cultural resources. TAR has recommended buffer radii of 150 feet for two of the clusters, and a buffer radius of 100 feet for remaining cluster to avoid adverse impacts to these three clusters of potentially significant resources, or additional diver identification surveys to assess their significance for inclusion in the National Register of Historic Places (NRHP). TAR has assessed the remaining 90 anomalies to be associated with insignificant dredge spoil material, riprap, or cables. In addition, no evidence of relict landforms associated with patterns of prehistoric activity were identified during the survey.

As a result of these investigations and to ensure protection of potentially significant submerged cultural resources, the Corps will buffer these three clusters with a buffer radius of 200 feet where no dredging, anchoring, or spudding will be permitted. Based on this information, the Corps has determined project activities occurring within the surveyed area will pose no effect to historic properties eligible for inclusion in the NRHP. Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470) and its implementing regulations (36 CFR 800), I request your comments on the determination of no effect for project activities within the surveyed area, and your comments on the draft report. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures

Scheler, Kristen L CIV USARMY CESAJ (US)

From: Tiemann, Marc Auguste CIV USARMY CESAJ (US)
Sent: Wednesday, June 21, 2017 10:58 AM
To: Scheler, Kristen L CIV USARMY CESAJ (US)
Subject: FW: Lake Worth Lagoon Project, Palm Beach County, FL

Kristen,

I'm forwarding the concurrence letter from the Seminole Tribe of Florida for the Lake Worth Lagoon Project. Select view in HTML to read on their letterhead.

Marc

Marc A. Tiemann, M.A., RPA
Archaeologist
Planning Division, Environmental Branch
USACE, Jacksonville District
701 San Marco Blvd.
Jacksonville, FL 32207

Phone: 904-232-1557

Email: marc.a.tiemann@usace.army.mil

From: Bradley Mueller [mailto:bradleymueller@semtribe.com]
Sent: Wednesday, June 21, 2017 9:29 AM
To: Ralph, Gina P CIV USARMY CESAJ (US) <Gina.P.Ralph@usace.army.mil>
Cc: Tiemann, Marc Auguste CIV USARMY CESAJ (US) <Marc.A.Tiemann@usace.army.mil>
Subject: [Non-DoD Source] Lake Worth Lagoon Project, Palm Beach County, FL

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE
AH-TAH-THI-KI MUSEUM

TRIBAL HISTORIC
PRESERVATION OFFICE

SEMINOLE TRIBE OF FLORIDA
AH-TAH-THI-KI MUSEUM

30290 JOSIE BILLIE HIGHWAY
PMB 1004
CLEWISTON, FL 33440

THPO PHONE: (863) 983-6549
MUSEUM PHONE: (863) 902-1113
FAX: (863) 902-1117

THPO WEBSITE: WWW.STOFTHPO.COM
MUSEUM WEBSITE: WWW.AHTAHTHIKI.COM



TRIBAL OFFICE

MARCELLUS W. OSC
CHAIRMAN

MITCHELL CYPRIAN
VICE CHAIRMAN

LAVONNE ROBERTSON
SECRETARY

PETER A. HARRIS
TREASURER

March 28, 2017

Ms. Gina Paduano Ralph, Ph.D.
Environmental Branch Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Subject: Lake Worth Lagoon Project, Palm Beach County, FL
THPO Compliance Tracking No.: 0029820

Dear Ms. Ralph,

Thank you for contacting the Seminole Tribe of Florida – Tribal Historic Preservation Office (STOF-THPO) regarding the Lake Worth Lagoon Project, Palm Beach County, FL. The proposed undertaking does fall within the STOF Area of Interest. We have reviewed the documents you provided and completed our project assessment pursuant to Section 106 of the National Historic Preservation Act and its implementing authority, 36 CFR 800, in order to determine if the undertaking would affect any areas important to the Tribe. We concur with your determination of no historic properties affected and we have no objections to the project at this time. Please notify us if any archaeological, historical, or burial resources are inadvertently discovered during project implementation. Thank you and feel free to contact us with any questions or concerns.

Respectfully,

Bradley M. Mueller, MA, Compliance Supervisor
STOF-THPO, Compliance Review Section
30290 Josie Billie Hwy, PMB 1004
Clewiston, FL 33440
Office: 863-983-6549 ext 12245

Email: bradleymueller@semtribe.com



FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

District Engineer
Jacksonville, USACE
701 San Marco Blvd.
Jacksonville, Florida 32207

March 24, 2017

RE: DHR Project File No.: 2017-1136, Received by DHR: February 28, 2017
Project: *Lake Worth Lagoon- Ecosystem Restoration Project*
County: Palm Beach

To whom it may concern:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places*. The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*.

We note that two cultural resources are recorded in or near the proposed project area: Historic structure 8PB10952, Peanut Island Coast Guard Station, and resource group 8PB06291, Peanut Island US Coast Guard Station, and both have been determined as eligible for the National Register. However, it is the opinion of this office that the project will have no adverse effects. We also recommend that the following condition included in the document in the event of unexpected finds:

- If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, *Florida Statutes*.

If you have any questions, please contact Rachel Thompson, Historic Sites Specialist, by email at Rachel.Thompson@dos.myflorida.com, or by telephone at 850.245.6333 or 800.847.7278.

Sincerely,

For

Timothy A Parsons, Ph.D., RPA
Director, Division of Historical Resources & State Historic Preservation Officer

Division of Historical Resources
R.A. Gray Building • 500 South Bronough Street • Tallahassee, Florida 32399
850.245.6300 • 850.245.6436 (Fax) FLHeritage.com





FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Mr. Marc Tiemann
Environmental Branch, Jacksonville USACE
P.O. Box 4970
Jacksonville, Florida 32232-0019

October 24, 2016

Re: DHR Project File No. 2016-3626/ Received by DHR: September 6, 2016
Applicant: U.S. Army Corps of Engineers
Project: Lake Worth Lagoon Project – Modify Six Potential Project Area
(Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park South and Bonefish Cove)
Proposed Improvement of Environmental Authorized under the Continuing Authorities Program (CAP)

Mr. Tiemann:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places*. The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*.

We note that two of the proposed project areas have been previously surveyed. This office concurs with the Corps that proposed activities in either of these two areas will have no effect on historic properties. We further concur that if any of the other four project areas are selected (Tarpon Flats, Snook East, Bryant Park South and Bonefish Cove) are selected, submerged remote sensing cultural resource assessment surveys should be conducted of these areas. The resultant survey report should conform to the provisions of Chapter 1A-46, *Florida Administrative Code*, and should be sent to our office upon completion. The report will help us complete the review process and provide comments or recommendations to the permitting agency in a timely fashion.

For questions, please contact Robin Jackson, Historic Preservationist, Compliance & Review at Robin.Jackson@dos.myflorida.com, or by telephone at 850.245.6496 or 800.847.7278.

Sincerely,

A handwritten signature in blue ink that reads "Jason Aldridge" with the word "For" written below it.

Timothy A. Parsons, Ph.D., RPA
Director, Division of Historical Resources and
State Historic Preservation Officer



TIDEWATER ATLANTIC RESEARCH, INC.

Dr. Gordon P. Watts, Jr., Director
Tele: 252.975.6659/Fax: 252.975.2828
Email: iimr@coastalnet.com

Post Office Box 2494
5290 River Road [Courier]
Washington NC 27889-2494

29 September 2016

Mr. Beau C. Suthard, PG
Coastal & Maritime Services
Environmental & Sustainability
CB&I
101 16th Avenue South, Suite 6
St. Petersburg, Florida 33701

Dear Mr. Suthard,

On 22 and 23 September 2016 a remote-sensing survey of a proposed environmental restoration site was carried out on the east side of the ICW channel in Lake Worth (Figure 1). The survey was conducted to locate and identify any magnetic anomalies and/or acoustic targets that could be associated with historic vessel remains and/or other potentially significant submerged cultural resources. Data was collected utilizing a GEOMETRICS cesium vapor magnetometer, EDGETECH dual-frequency digital sidescan sonar, and EDGETECH chirp sub-bottom profiler. Survey navigation and data collection was controlled by an onboard computer connected to a TRIMBLE differential global positioning system also running HYPACK survey software. Data was collected along 17 survey lines spaced at 30 meters (Figure 1).

Where beneficial for anomaly characterization and assessment, additional lines of data were generated in between the 30-meter survey lines. Preliminary analysis of the magnetic data was carried out using HYPACK to identify and characterize anomalies in the survey area. SONARWIZ software was used to carry out a preliminary assessment of the acoustic data. With the exception of charted shallow water areas in the northeastern and southeastern corners of the study area, and a concentration of jetty debris west of manmade land extending into the area from the east shoreline, the survey extended from the east side of the ICW navigation channel to shallow water off the Palm Beach shoreline.

Analysis of the magnetometer data identified a total of 96 anomalies (Attachment A). Twenty-six of the anomalies are associated with charted cables or pipelines at the northern and southern extremities of the survey area. Magnetic data indicates that some of the cable or pipeline as built alignments extend outside the designated corridor and into the survey area. Four magnetic anomalies are associated with ICW navigation references. Six more magnetic anomalies appear to be debris associated with channel stabilization jetties that are west of the manmade land extending into the survey area approximately 800 feet south of the north survey area border (Figure 2).

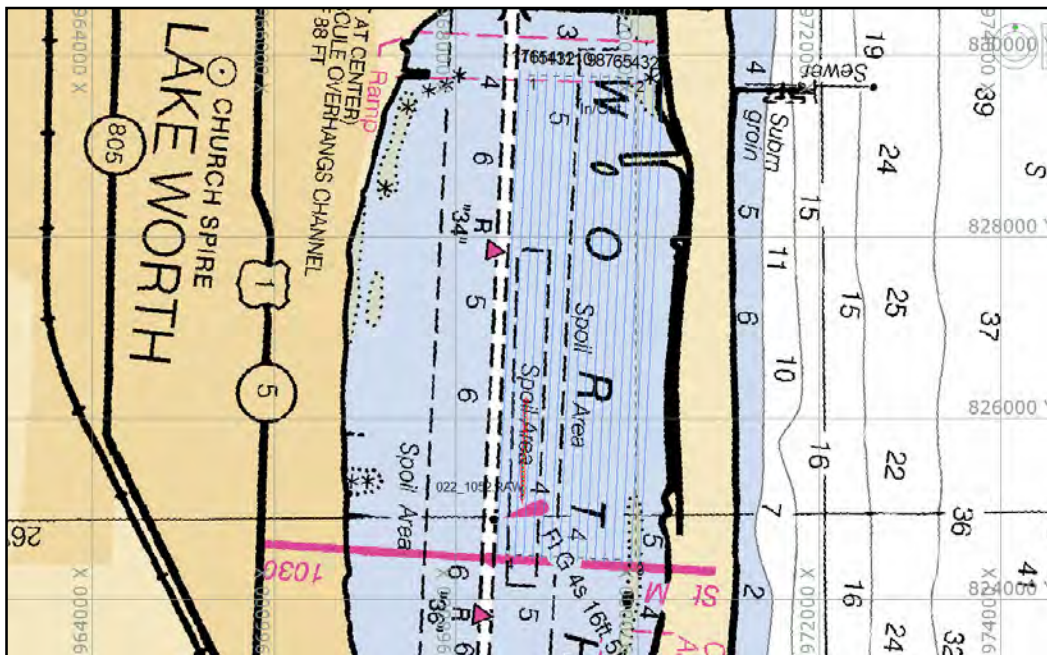


Figure 1. Lake Worth survey area and planned survey lines.



Figure 2. Chart showing the cable or pipeline crossing at the northern border of the survey area and channel stabilization jetties west of the manmade land that extend into the survey area from the east shore of Lake Worth.

Two magnetic anomalies appear to be associated with moderate size ferrous objects such as anchors, chain, pipes or other modern debris. Fifty-one magnetic anomalies are generated by small single objects such as small anchors, moorings, small boat hardware, pipe, light chain, cable, fish traps, or other similar debris. Two small magnetic anomalies and one moderate anomaly have slightly more complex signatures that suggest the presence of more than one object similar to those listed above in association with small single objects.

The remaining four magnetic anomalies; 15-3-dp-212.6g-186.9f, 16-5-mc-14.8g-441.8f, 18-1-mc-227.2g-445f, and 22-1-nm-11g-272f have signature characteristics that could be associated with historic vessel remains. Anomalies 15-3-dp-212.6g-186.9f and 22-1-nm-11g-272f form one cluster and are identified by Potential Buffer 1. Anomalies 16-5-mc-14.8g-441.8f and 18-1-mc-227.2g-445f form a second cluster and are identified by Potential Buffer 2 (Figure 3). No acoustic data images are associated with magnetic anomalies within the potential buffer sites. Although those two anomaly clusters have signature characteristics that could be associated with historic vessel remains, it is also possible that they are generated by material deposited in the survey area in association with channel or other dredging activity.



Figure 3. Potential Buffer 1 and Potential Buffer 2 sites shown in red.

Most of the survey area is clearly identified as charted "Spoil Area." Spoil areas frequently contain extensive deposits of modern debris. Although the four signatures are strongly suggestive of a potential association with vessel remains, only ground truthing will produce a positive identification of material generating the signatures and support a conclusive historical significance assessment. With the exception of those four signatures, none of the remaining magnetic anomalies appear to have a potential association with potentially significant submerged cultural resources. At this point in the preliminary data analysis process, only the two anomaly clusters appear to merit any additional investigation. In the event that project activities can be designed to avoid the two site buffers, no additional investigation is recommended.

Best regards,

Gordon P. Watts, Jr., Ph.D, RPA
Principal Investigator

ATTACHMENT A: LAKE WORTH MAGNETIC ANOMALY TABLE									
	Anomaly	X Coordinate	Y Coordinate	Survey Line	Anomaly on Line	Signature	Intensity	Duration	Assessment
3	01-1-mc-1447.2g-74.2f	970019.8	829795.2	1	1	Multicomponent	1447.2g	74.2f	Cable or Pipeline
4	03.1-1-mc-637.3g-81.3f	970008.3	829579.9	3.1	1	Multicomponent	637.3g	81.3f	Cable or Pipeline
5	03.1-2-dp-724.3g-32.3f	970026.5	829506	3.1	2	Dipolar	724.3g	32.3f	Cable or Pipeline
6	04.1-1-mc-779.7g-107.5f	969955.7	829809.1	4.1	1	Multicomponent	779.7g	107.5f	Cable or Pipeline
7	05.1-1-mc-934.9g-91.6f	969894.2	829579.5	5.1	1	Multicomponent	934.9g	91.6f	Cable or Pipeline
8	06.1-1-mc-394.5g-102.3f	969787.3	829816.2	6.1	1	Multicomponent	394.5g	102.3f	Cable or Pipeline
9	07.2-1-mc-672.4g-143f	969695.6	829598	7.2	1	Multicomponent	672.4g	143f	Cable or Pipeline
10	08.1-2-mc-438.1g-184.1f	969594.2	829607	8.1	2	Multicomponent	438.1g	184.1f	Cable or Pipeline
11	08-1-mc-462.2g-190.9f	969601	829610.7	8	1	Multicomponent	462.2g	190.9f	Cable or Pipeline
12	09.1-1-mc-517g-196f	969493.9	829626.2	9.1	1	Multicomponent	517g	196f	Cable or Pipeline
13	09-1-mc-380.6g-189.3f	969488.6	829889.1	9	1	Multicomponent	380.6g	189.3f	Cable or Pipeline
14	10.2-1-mc-364.5g-193.6f	969394.7	829874.6	10.2	1	Multicomponent	364.5g	193.6f	Cable or Pipeline
15	10-1-mc-339.8g-220.8f	969386.8	829643.8	10	1	Multicomponent	339.8g	220.8f	Cable or Pipeline
16	11.1-1-mc-646.3g-206.9f	969292.7	829632.4	11.1	1	Multicomponent	646.3g	206.9f	Cable or Pipeline
17	11-1-mc-407.8g-196.3f	969285.2	829894.6	11	1	Multicomponent	407.8g	196.3f	Cable or Pipeline
18	12.1-1-mc-437.1g-245.7f	969202.4	829888.3	12.1	1	Multicomponent	437.1g	245.7f	Cable or Pipeline
19	12-1-mc-335.1g-279.7g	969186.4	829655.2	12	1	Multicomponent	335.1g	279.7g	Cable or Pipeline
20	13.1-1-mc-487.2g-225f	969104.1	829645.7	13.1	1	Multicomponent	487.2g	225f	Cable or Pipeline
21	13-11-mc-440.8g-246.5f	969105.7	829899.4	13	11	Multicomponent	440.8g	246.5f	Cable or Pipeline
22	14.1-1-mc-368.6g-287.9f	969008.6	829829.9	14.1	1	Multicomponent	368.6g	287.9f	Cable or Pipeline
23	14-1-dp-262.6g-148.6f	968994.6	829686.4	14	1	Dipolar	262.6g	148.6f	Cable or Pipeline
24	15-1-mc-1294g-224.8f	968911	829963.6	15	1	Multicomponent	1294g	224.8f	Cable or Pipeline
25	16-1-mc-164.5g-390.9f	968799.2	829693.4	16	1	Multicomponent	164.5g	390.9f	Cable or Pipeline
26	17.2-1-mc-295.6g-237.5f	968700.2	829657.7	17.2	1	Multicomponent	295.6g	237.5f	Cable or Pipeline
27	17-1-dp-231.4g-112.7f	968666.8	829710.8	17	1	Dipolar	231.4g	112.7f	Cable or Pipeline
28	17-2-pm-138.9g-66.1f	968695.2	829594.9	17	2	Positive Monopolar	138.9g	66.1f	Cable or Pipeline
29	16-6-mc-16.1g-343.3f	968573.8	824809.3	16	6	Multicomponent	16.1g	343.3f	Green Day Board
30	17.2-5-nm-415.8g-449.6f	968464.2	824812.8	17.2	5	Negative Monopolar	415.8g	449.6f	Green Day Board
31	17-3-nm-399.9g-368.9f	968474.1	824823.7	17	3	Negative Monopolar	399.9g	368.9f	Green Day Board
32	21-2-mc-31.4g-454.8f	968532.3	825049.6	21	2	Multicomponent	31.4g	454.8f	Green Day Board
33	08.1-1-dp-269.5g-21f	969522.6	828653.6	8.1	1	Dipolar	269.5g	21f	Jetty Debris
34	09.1-2-mc-113g-60.4f	969445.6	828675.8	9.1	2	Multicomponent	113g	60.4f	Jetty Debris
35	10.2-2-dp-36.4g-23.3f	969363.1	829307.8	10.2	2	Dipolar	36.4g	23.3f	Jetty Debris
36	11-2-mc-98.3g-125.9f	969252	828833.1	11	2	Multicomponent	98.3g	125.9f	Jetty Debris
37	19-3-nm-14.6g-22.3f	969309	828816.2	19	3	Negative Monopolar	14.6g	22.3f	Jetty Debris
38	20.1-2-nm-2.6g-142.9f	969197	828599.1	20.1	2	Negative Monopolar	2.6g	142.9f	Jetty Debris
39	11-3-nm-80.7g-66.9f	969126.8	826126.8	11	3	Negative Monopolar	80.7g	66.9f	Moderate Single Object
40	13.1-2-dp-194.6g-65.8f	968968.5	827012.6	13.1	2	Dipolar	194.6g	65.8f	Moderate Single Object
41	23-2-mc-244.9g-54.7f	969427.2	829389.8	23	2	Multicomponent	244.9g	54.7f	Moderate Single Object (s)
42	15-3-dp-212.6g-186.9f	968727.6	825960.1	15	3	Dipolar	212.6g	186.9f	Possible Vessel Remains
43	16-5-mc-14.8g-441.8f	968617.4	825663.5	16	5	Multicomponent	14.8g	441.8f	Possible Vessel Remains
44	18-1-mc-227.2g-445f	968654.8	825651.6	18	1	Multicomponent	227.2g	445f	Possible Vessel Remains

	A	B	C	D	E	F	G	H	I
2	Anomaly	X Coordinate	Y Coordinate	Survey Line	Anomaly on Line	Signature	Intensity	Duration	Assessment
45	22-1-nm-11g-272f	968767.5	825963.5	22	1	Negative Monopolar	11g	272f	Possible Vessel Remains
46	01-2-pm-32.2g-16.4f	970183.7	828051.3	1	2	Positive Monopolar	32.2g	16.4f	Small Single Object
47	01-3-pm-24.8g-20.5f	970162.6	828024.8	1	3	Positive Monopolar	24.8g	20.5f	Small Single Object
48	01-4-pm-24g-13.2f	970136.4	827972.1	1	4	Positive Monopolar	24g	13.2f	Small Single Object
49	02-1-dp-10.2g-59.3f	970144.4	828564	2	1	Dipolar	10.2g	59.3f	Small Single Object
50	02-1-dp-10.2g-59.3f	970076.4	827386.3	2	1	Dipolar	10.2g	59.3f	Small Single Object
51	02-2-dp-10.2g-66.1f	970067.8	827135.3	2	2	Dipolar	10.2g	66.1f	Small Single Object
52	02-3-dp-8.1g-20.7f	969980.4	825510.9	2	3	Dipolar	8.1g	20.7f	Small Single Object
53	03-1-pm-3.4g-17.9f	969978.7	827689.2	3	1	Positive Monopolar	3.4g	17.9f	Small Single Object
54	03-3-dp-5.7g-34.3f	969941.3	826755.2	3	3	Dipolar	5.7g	34.3f	Small Single Object
55	04-1-pm-35.2g-59.7f	969832.1	826389.7	4	1	Positive Monopolar	35.2g	59.7f	Small Single Object
56	04-2-pm-2.6g-25.8f	969730.4	824383.7	4	2	Positive Monopolar	2.6g	25.8f	Small Single Object
57	05.2-1-dp-7g-39.3f	969802.6	827929.7	5.2	1	Dipolar	7g	39.3f	Small Single Object
58	06-1-dp-11.5g-40.6f	969724.6	828344.6	6	1	Dipolar	11.5g	40.6f	Small Single Object
59	07.3-1-dp-13.4g-33.1f	969548.1	826758.2	7.3	1	Dipolar	13.4g	33.1f	Small Single Object
60	07-1-dp-3.1g-39.5f	969544.9	826755.2	7	1	Dipolar	3.1g	39.5f	Small Single Object
61	09.1-3-nm-2.9g-23.2f	969264.8	824947.4	9.1	3	Negative Monopolar	2.9g	23.2f	Small Single Object
62	09-2-dp-48.7g-38.4f	969456.6	829533	9	2	Dipolar	48.7g	38.4f	Small Single Object
63	09-3-dp-11g-46f	969438.2	829385.9	9	3	Dipolar	11g	46f	Small Single Object
64	10.1-1-nm-16.9g-78.9f	969318.5	828059.3	10.1	1	Negative Monopolar	16.9g	78.9f	Small Single Object
65	10.1-2-dp-12.8g-43.5f	969288.2	827460.3	10.1	2	Dipolar	12.8g	43.5f	Small Single Object
66	10.1-3-dp-14.1g-50.8f	969263.1	826841.2	10.1	3	Dipolar	14.1g	50.8f	Small Single Object
67	10.2-3-dp-7.3g-19f	969356.9	828983.3	10.2	3	Dipolar	7.3g	19f	Small Single Object
68	10-2-pm-40.7g-23.2f	969362.5	829070.1	10	2	Positive Monopolar	40.7g	23.2f	Small Single Object
69	10-3-nm-22.2g-55.9f	969307.7	827824.7	10	3	Negative Monopolar	22.2g	55.9f	Small Single Object
70	10-4-dp-87.4g-45.7f	969128.4	824522.9	10	4	Dipolar	87.4g	45.7f	Small Single Object
71	12.11-3-dp-24.6g-51.1f	969059.4	826869.7	12.11	3	Dipolar	24.6g	51.1f	Small Single Object
72	12.1-2-dp-7.1g-38.9f	969100.1	827686.2	12.1	2	Dipolar	7.1g	38.9f	Small Single Object
73	12.1-4-pm-18.2g-42.9f	968967.5	824860.3	12.1	4	Positive Monopolar	18.2g	42.9f	Small Single Object
74	12-2-nm-5.8g-28.2f	969056.6	826633.4	12	2	Negative Monopolar	5.8g	28.2f	Small Single Object
75	12-3-pm-2.9g-48.4f	968966.7	824618.1	12	3	Positive Monopolar	2.9g	48.4f	Small Single Object
76	13-2-nm-36.3g-42.8f	968982.4	827257.9	13	2	Negative Monopolar	36.3g	42.8f	Small Single Object
77	13-3-dp-7.1g-21.2f	968883	825167.5	13	3	Dipolar	7.1g	21.2f	Small Single Object
78	14.1-2-mc-53.6g-76.4f	968918.3	827916.6	14.1	2	Multicomponent	53.6g	76.4f	Small Single Object
79	14.1-3-pm-5.5g-33.8f	968768	825014.5	14.1	3	Positive Monopolar	5.5g	33.8f	Small Single Object
80	15-2-pm-10.9g-42.1f	968759.8	826811	15	2	Positive Monopolar	10.9g	42.1f	Small Single Object
81	15-4-pm-10.7g-57.7f	968688.3	825116.7	15	4	Positive Monopolar	10.7g	57.7f	Small Single Object
82	16-2-pm-3.5g-74.6f	968725.3	827805	16	2	Positive Monopolar	3.5g	74.6f	Small Single Object
83	16-3-pm-6.8g-52.3f	968696.3	827420.9	16	3	Positive Monopolar	6.8g	52.3f	Small Single Object
84	16-4-dp-9.5g-106f	968655.5	826469.7	16	4	Dipolar	9.5g	106f	Small Single Object
85	16-7-dp-4.9g-83.9f	968556.6	824512.7	16	7	Dipolar	4.9g	83.9f	Small Single Object
86	16-8-pm-1.8g-39.6f	968544.7	824260.3	16	8	Positive Monopolar	1.8g	39.6f	Small Single Object
87	17.2-2-pm-6.7g-32.7f	968630.4	828156.2	17.2	2	Positive Monopolar	6.7g	32.7f	Small Single Object

	A	B	C	D	E	F	G	H	I
2	Anomaly	X Coordinate	Y Coordinate	Survey Line	Anomaly on Line	Signature	Intensity	Duration	Assessment
88	17.2-3-pm-15.1g-42f	968613.1	827616.1	17.2	3	Positive Monopolar	15.1g	42f	Small Single Object
89	17.2-4-dp-17.7g-41.7f	968599.6	827417.8	17.2	4	Dipolar	17.7g	41.7f	Small Single Object
90	19-2-dp-11.2g-38.2f	969309.6	828968	19	2	Dipolar	11.2g	38.2f	Small Single Object
91	19-4-dp-8.9g-55.6f	969262.2	828064.7	19	4	Dipolar	8.9g	55.6f	Small Single Object
92	20.1-1-nm-2.4g-38.4f	969222.3	829171.1	20.1	1	Negative Monopolar	2.4g	38.4f	Small Single Object
93	20-1-nm-2g-85.4f	969066.5	825890.2	20	1	Negative Monopolar	2g	85.4f	Small Single Object
94	21-1-dp-6.5g-53.7f	968573.2	825914.4	21	1	Dipolar	6.5g	53.7f	Small Single Object
95	21-3-nm-4.4g-41f	968506.5	824306.5	21	3	Negative Monopolar	4.4g	41f	Small Single Object
96	23-1-dp-40.2g-22.2f	969426.4	829532.2	23	1	Dipolar	40.2g	22.2f	Small Single Object
97	03-2-mc-40.4g-87.9f	969950.5	826894.7	3	2	Multicomponent	40.4g	87.9f	Small Single Object(s)
98	19-1-mc-83.8g-42.2f	969326.4	829304.2	19	1	Multicomponent	83.8g	42.2f	Small Single Object(s)



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

AUG 30 2016

Planning and Policy Division
Environmental Branch

Tim Parsons, Ph.D.
Division of Historical Resources
State Historic Preservation Officer
500 South Bronough Street
Tallahassee, Florida 32399-0250

Re: Lake Worth Lagoon Project:

Dear Dr. Parsons:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with modifying six potential project areas (Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove) for proposed improvement of the environment authorized under the Continuing Authorities Program (CAP) Section 1135 (Figure 1). Restorative activities include, but are not limited to, placement of a thin layer of sand on muck sediment to create seagrass habitat, creation of small islands of cordgrass and mangrove habitat, and placement of limestone rock for stabilization and oyster habitat.

A 2000 submerged cultural resources survey conducted by Mid-Atlantic Technology and Environmental Research, Inc. covered the Currie Park and El Cid potential project sites identifying nineteen potentially significant submerged targets along the intracoastal waterway. None of the previously identified nineteen targets were determined to meet the eligibility criteria for inclusion in the National Register of Historic Places (DHR No. 2000-0019). Since Currie Park and El Cid have been previously surveyed, the Corps has determined that if either of these sites is selected for restoration activities that no additional surveys are necessary. The Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove potential project areas have not been subject to submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the Florida Master Site File (FMSF). Based upon review of the FMSF and best professional judgement, the Corps determined that submerged remote sensing cultural resources survey is needed if any of these areas are selected for the project. The purpose of the survey will be to determine if any resources exist within the four proposed locations and evaluate their significance.

The Corps respectfully requests your concurrence on this determination. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,

A handwritten signature in black ink, appearing to read "Gina Paduano Ralph". The signature is fluid and cursive, with a large loop at the end.

Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures



Figure 1. Map of potential project areas and previously identified archaeological sites.



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

AUG 30 2016

Planning and Policy Division
Environmental Branch

Mr. Fred Dayhoff, Tribal Representative
NAGPRA, Section 106
Miccosukee Tribe of Indians of Florida
HC 61
SR68
Ochopee, Florida 34141

Lake Worth Lagoon Project:

Dear Mr. Dayhoff:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with modifying six potential project areas (Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove) for proposed improvement of the environment authorized under the Continuing Authorities Program (CAP) Section 1135 (Figure 1). Restorative activities include, but are not limited to, placement of a thin layer of sand on muck sediment to create seagrass habitat, creation of small islands of cordgrass and mangrove habitat, and placement of limestone rock for stabilization and oyster habitat.

A 2000 submerged cultural resources survey conducted by Mid-Atlantic Technology and Environmental Research, Inc. covered the Currie Park and El Cid potential project sites identifying nineteen potentially significant submerged targets along the intracoastal waterway. None of the previously identified nineteen targets were determined to meet the eligibility criteria for inclusion in the National Register of Historic Places (DHR No. 2000-0019). Since Currie Park and El Cid have been previously surveyed, the Corps has determined that if either of these sites is selected for restoration activities that no additional surveys are necessary. The Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove potential project areas have not been subject to submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the Florida Master Site File (FMSF). Based upon review of the FMSF and best professional judgement, the Corps determined that submerged remote sensing cultural resources survey is needed if any of these areas are selected for the project. The purpose of the survey will be to determine if any resources exist within the four proposed locations and evaluate their significance.

The Corps respectfully requests your concurrence on this determination within 30 days of receipt of this letter. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures



Figure 1. Map of potential project areas and previously identified archaeological sites.



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

AUG 30 2016

Planning and Policy Division
Environmental Branch

Dr. Paul Backhouse, THPO
Seminole Tribe of Florida
Tribe Historic Preservation Office
30290 Josie Billie Highway
PMP 1004
Clewiston, FL 33440

Lake Worth Lagoon Project:

Dear Dr. Backhouse:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is studying the environmental effects associated with modifying six potential project areas (Currie Park, El Cid, Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove) for proposed improvement of the environment authorized under the Continuing Authorities Program (CAP) Section 1135 (Figure 1). Restorative activities include, but are not limited to, placement of a thin layer of sand on muck sediment to create seagrass habitat, creation of small islands of cordgrass and mangrove habitat, and placement of limestone rock for stabilization and oyster habitat.

A 2000 submerged cultural resources survey conducted by Mid-Atlantic Technology and Environmental Research, Inc. covered the Currie Park and El Cid potential project sites identifying nineteen potentially significant submerged targets along the intracoastal waterway. None of the previously identified nineteen targets were determined to meet the eligibility criteria for inclusion in the National Register of Historic Places (DHR No. 2000-0019). Since Currie Park and El Cid have been previously surveyed, the Corps has determined that if either of these sites is selected for restoration activities that no additional surveys are necessary. The Tarpon Flats, Snook East, Bryant Park South, and Bonefish Cove potential project areas have not been subject to submerged cultural resources surveys, and are in close proximity to archaeological sites recorded at the Florida Master Site File (FMSF). Based upon review of the FMSF and best professional judgement, the Corps determined that submerged remote sensing cultural resources survey is needed if any of these areas are selected for the project. The purpose of the survey will be to determine if any resources exist within the four proposed locations and evaluate their significance.

The Corps respectfully requests your concurrence on this determination within 30 days of receipt of this letter. If there are any questions, please contact Mr. Marc Tiemann at 904-232-1557 or email at Marc.A.Tiemann@usace.army.mil.

Sincerely,



Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosures

cc:

Anne Mullins, Deputy Tribal Historic Preservation Officer, Seminole Tribe of Florida, 30290
Josie Billie Highway, PMP 1004, Clewiston, Florida 33440

Bradley Mueller, Compliance Review, Seminole Tribe of Florida, 30290 Josie Billie Highway,
PMP 1004, Clewiston, Florida, 33440



Figure 1. Map of potential project areas and previously identified archaeological sites.

Appendix D – Environmental
Attachment 5: Public and Agency Comments and Corps' Responses
Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) Project

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Table 1 Summary of USACE responses to comments received during the agency and public review and comment period of the Lake Worth Lagoon 1135 CAP project’s draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) and proposed Finding of No Significant Impact (FONSI)

#	Commenter	Comment	Response
1	Florida State Clearinghouse, on behalf of the Division of Historic Resources (DHR) and State Historic Preservation Officer (SHPO)	Two cultural resources are recorded in or near the proposed project area: Historic structure 8PB10952, Peanut Island Coast Guard Station, and resource group 8PB06291, Peanut Island US Coast Guard Station, and both have been determined as eligible for the National Register. However, it is the opinion of DHR and SHPO that the project will have no adverse effects. The following condition is recommended for inclusion in the document in the event of unexpected finds: “If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.” (NOTE: The same	Thank you for your comment. The recommended condition has been incorporated into the final IFR/EA under section 3.5.8.6 “Cultural Resources and Historic Properties”.

		comments were also received via letter from DHR and SHPO.)	
2	Florida State Clearinghouse	The state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes.	Noted. Thank you for your comment.
3	Miccosukee Tribe of Indians of Florida	Fred Dayhoff relayed that the Miccosukee Tribe of Indians of Florida have "no problems with the project" via telephone call on March 3, 2017 at approximately 1:00pm.	Noted. Thank you for your comment.
4	Advisory Council on Historic Preservation (ACHP)	Should the Army Corps of Engineers, through consultation with the FL SHPO, tribes, and other consulting parties, alter its current determination from that of no effect to historic properties to that of an adverse effect, please invite the ACHP to participate at that time, pursuant to our regulations 36CFR800.6(a)(1).	Noted. Thank you for your comment.
5	Environmental Protection Agency (EPA) – Region 4	Explain the budget constraints of the CAP and implications to the project within the Final EA.	Thank you for your comment. Additional information has been incorporated into the final IFR/EA under the "Authorization" (in the Executive Summary) and section 3 "Plan Formulation".
6	EPA – Region 4	Explain the discussions and consultation efforts with the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida in regard to the section 106 responsibilities within the Final EA.	Thank you for your comment. Additional information has been incorporated into the final IFR/EA under sections 2.4.9 and 3.5.8.18 "Native Americans" describing the outcome of discussions and consultation efforts.
7	EPA – Region 4	Explain what methodology was used to determine there were no RCRA or CERCLA waste sites located within the project area in the Final EA.	Thank you for your comment. Additional information has been incorporated into the final IFR/EA under section 2.4.11 "Hazardous, Toxic, and Radioactive Materials".

8	EPA – Region 4	Separately discuss the monitoring and adaptive management plan in its own section (separate from the Other Alternatives Considered but Screened Out section). The USACE should include, at a minimum, a 5 year monitoring plan, which includes supplemental planting, should seagrass not recruit within 3 years.	Thank you for your comment. A monitoring and adaptive management plan is included as Appendix E in the IFR/EA. The plan includes annual monitoring and recommends supplemental planting via transplanting if seagrass success criteria is not met. The discussion regarding the monitoring and adaptive management plan will be removed from chapter 3 and inserted into section 4.2.1 “Plan Implementation Requirements” of the final IFR/EA.
9	EPA – Region 4	Retitle the “Cooperating Agencies” section to “State and Federal Coordination” in the Final EA as a cooperating agency is a formal process that requires documentation and the EPA was not invited to act as a Cooperating Agency.	Thank you for your comment. This recommendation has been incorporated into the final IFR/EA.
10	EPA – Region 4	The proposed project site is located in close proximity to the Intercoastal Waterway. Consider including measures to protect seagrasses from wave action.	Thank you for your comment. Wave climate was part of the criteria for site selection. In addition, the project is designed to create seagrass habitat surrounding the mangrove islands and oyster reefs. Seagrass habitat created behind the islands and oyster reefs will be protected by those features, which act as a natural wave break. Although the proposed habitat on the Intercoastal Waterway will be more susceptible to wave energy, it is anticipated that seagrasses will still recruit and grow based on the successful recruitment and growth at Snook Islands Restoration Area.
11	Seminole Tribe of Florida – Tribal Historic Preservation Office (STOF-THPO)	The proposed undertaking does fall within the STOF Area of interest. The STOF-THPO have no objections to the project at this time and look forward to reviewing the proposed submerged cultural resources	Noted. Thank you for your comment.

		survey report when it becomes available.	
--	--	--	--

Scheler, Kristen L CIV USARMY CESAJ (US)

From: Bradley Mueller <bradleymueller@semtribe.com>
Sent: Tuesday, April 18, 2017 10:57 AM
To: Scheler, Kristen L CIV USARMY CESAJ (US)
Subject: [Non-DoD Source] FW: Lake Woth Lagoon 1135 CAP Project

From: Bradley Mueller
Sent: Tuesday, April 18, 2017 10:51 AM
To: Gina.P.Ralph@usace.army.mil
Cc: 'Kristin.L.Scheler@usdace.army.mil'
Subject: Lake Woth Lagoon 1135 CAP Project



April 18, 2017

Ms. Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch
Planning and Policy Division, Environmental Branch
Jacksonville District Corps of Engineers
701 San Marco Blvd.
Jacksonville, FL 32207-0019

Subject: Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA) for the Lake Worth Lagoon 1135 Continuing Authorities Program, Palm Beach County, Florida
THPO #: 0029409

Dear Ms. Ralph,

Thank you for contacting the Seminole Tribe of Florida – Tribal Historic Preservation Office (STOF-THPO) regarding the Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA) for the Lake Worth Lagoon 1135 Continuing Authorities Program, Palm Beach County, Florida. The proposed undertaking does fall within the STOF Area of Interest. We have reviewed the draft IFR/EA and completed our assessment pursuant to Section 106 of the National Historic Preservation Act and its implementing authority, 36 CFR 800. We have no objections to the project at this time and look forward to reviewing the proposed submerged cultural resources survey report when it becomes available. Please feel free to contact us with any questions or concerns.

Respectfully,

Bradley M. Mueller

Bradley M. Mueller, MA, Compliance Supervisor
STOF-THPO, Compliance Review Section
30290 Josie Billie Hwy, PMB 1004
Clewiston, FL 33440
Office: 863-983-6549 ext 12245
Fax: 863-902-1117
Email: bradleymueller@semtribe.com
Web: Blockedwww.stofthpo.com



From: [Higgins, Jamie](#)
To: [Scheler, Kristen L CIV USARMY CESAJ \(US\)](#)
Cc: [Higgins, Jamie](#); [Militcher, Chris](#)
Subject: [Non-DoD Source] Lake Worth Lagoon EA-EPA Comments
Date: Friday, April 14, 2017 8:22:46 AM
Attachments: [Lake Worth 1135 EA-Final comments.CAM.pdf](#)

Kristen,

Please find attached EPA's comments on the Lake Worth Lagoon 1135 EA. Please feel free to contact me should you have questions.

Thanks,

Jamie

Jamie Higgins

EPA Region 4

NEPA Program Office

Sam Nunn Atlanta Federal Center

61 Forsyth Street, SW

Atlanta, GA 30303

404-562-9681

Higgins.jamie@epa.gov

Jacksonville District, US Army Corps of Engineers
Lake Worth Lagoon 1135 Continuing Authorities Program Environmental Assessment
US Environmental Protection Agency Comments
April 14, 2017

1. On page ES-10, the US Army Corps of Engineers (USACE) states that they are eliminating alternatives because they “would have been cost-prohibitive under a limited CAP budget”. Also on page 3-3, the USACE makes the same comment when discussing screening of management measures. Recommendation: For clarification, the Environmental Protection Agency (EPA) recommends that the USACE explain the budget constraints of the CAP and implications to the project within the Final EA.

2. On page 2-34 (Native Americans), the USACE states, “USACE has discussed this project with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida in regard to its Section 106 responsibilities under the National Historic Preservation Act (NHPA).” However, the USACE does not explain the outcome of those discussions within the EA. Recommendation: The EPA recommends that the USACE better explain these discussions and discuss consultations efforts with the tribes in the Final EA.

3. On page 2-34 (Hazardous, Toxic and Radioactive Materials), the USACE states that there are no known hazardous or toxic material within the project area, but does not explain how they have come to that conclusion. Recommendation: The EPA recommends that the USACE explain what methodology was used to determine that there were no RCRA or CERCLA waste sites located within the project area in the Final EA.

4. On page 3-9 (Other Alternatives Considered But Screened Out), the USACE discusses “Project Sustainability” and discusses the development of a Monitoring and Adaptive Management Plan. The EPA acknowledges the importance of discussing the Monitoring and Adaptive Management plan and the long-term sustainability of the project; however, it seems like this paragraph has been inappropriately placed in the “Other Alternatives Considered But Screened Out” section. Recommendation: The EPA recommends that the USACE separately discuss the Monitoring and Adaptive Management Plan in its own section (separate from the Other Alternatives Considered But Screened Out section). The EPA also recommends that the USACE include at a minimum, a 5 year monitoring plan, which includes supplemental planting should seagrass not recruit within 3 years.

5. On page 5.2 (Cooperating Agencies), the USACE discusses various agencies are “Cooperating Agencies” and lists EPA as a cooperating agency. The Cooperating Agency status is discussed within 40 CFR 1501.6 and requires the lead federal agency to invite other federal agencies to participate as a Cooperating Agency. It is a formal process that requires documentation. To our knowledge, we were not invited to act as a Cooperating Agency, but would accept an invitation should it be extended to us. Recommendation: The EPA

recommends that the USACE more appropriately title this section as “State and Federal Coordination” in the Final EA.

6. The proposed project (figure 4-3) is located in close proximity to the Intercostal Waterway which may impact the seagrass area by wave action. Protective measures may need to be incorporated to ensure wave action is reduced in the seagrass recruitment area. The lack of wave action protection may be the reason why no seagrass is located on the west side, adjacent to Intercostal Waterway. Recommendation: The EPA recommends that the USACE consider including measures to protect seagrass from wave action.

Scheler, Kristen L CIV USARMY CESAJ (US)

From: Stahl, Chris <Chris.Stahl@dep.state.fl.us>
Sent: Monday, April 10, 2017 2:23 PM
To: Scheler, Kristen L CIV USARMY CESAJ (US)
Subject: [Non-DoD Source] State_Clearance_Letter_For_FL201702287919C-DIFR&EA for Lake Worth Lagoon 1135 Continuing Authorities Program, Palm Beach County,

April 10, 2017

Kristen Scheler
US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

RE: Department of the Army, Jacksonville District Corps of Engineers - Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA) for Lake Worth Lagoon 1135 Continuing Authorities Program (CAP), Palm Beach County, Florida.
SAI # FL201702287919C

Dear Kristen:

Florida State Clearinghouse staff has reviewed the proposal under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

We note that two cultural resources are recorded in or near the proposed project area: Historic structure 8PB10952, Peanut Island Coast Guard Station, and resource group 8PB06291, Peanut Island US Coast Guard Station, and both have been determined as eligible for the National Register. However, it is the opinion of the Division of Historical Resources & State Historic Preservation Officer that the project will have no adverse effects. If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes. If you have any questions, please contact Alyssa Costas, Historic Sites Specialist, by email at Alyssa.Costas@dos.myflorida.com, or by telephone at 850.245.6333 or 800.847.7278.

Based on the information submitted and minimal project impacts, the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes.

Thank you for the opportunity to review the proposed plan. If you have any questions or need further assistance, please don't hesitate to contact me at (850) 717-9076.

Sincerely,

Chris Stahl

Chris Stahl, Coordinator
Florida State Clearinghouse
Florida Department of Environmental Protection
2600 Blair Stone Road, M.S. 47
Tallahassee, FL 32399-2400
ph. (850) 717-9076
State.Clearinghouse@dep.state.fl.us





FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

District Engineer
Jacksonville, USACE
701 San Marco Blvd.
Jacksonville, Florida 32207

March 24, 2017

RE: DHR Project File No.: 2017-1136, Received by DHR: February 28, 2017
Project: *Lake Worth Lagoon- Ecosystem Restoration Project*
County: Palm Beach

To whom it may concern:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places*. The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*.

We note that two cultural resources are recorded in or near the proposed project area: Historic structure 8PB10952, Peanut Island Coast Guard Station, and resource group 8PB06291, Peanut Island US Coast Guard Station, and both have been determined as eligible for the National Register. However, it is the opinion of this office that the project will have no adverse effects. We also recommend that the following condition included in the document in the event of unexpected finds:

- If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, *Florida Statutes*.

If you have any questions, please contact Rachel Thompson, Historic Sites Specialist, by email at Rachel.Thompson@dos.myflorida.com, or by telephone at 850.245.6333 or 800.847.7278.

Sincerely,

For

Timothy A Parsons, Ph.D., RPA
Director, Division of Historical Resources & State Historic Preservation Officer

Division of Historical Resources
R.A. Gray Building • 500 South Bronough Street • Tallahassee, Florida 32399
850.245.6300 • 850.245.6436 (Fax) FLHeritage.com



Scheler, Kristen L CIV USARMY CESAJ (US)

From: Chris Daniel <cdaniel@achp.gov>
Sent: Wednesday, March 08, 2017 11:59 AM
To: Scheler, Kristen L CIV USARMY CESAJ (US)
Subject: [EXTERNAL] Draft Feasibility Report and EA for Lake Worth Lagoon

Ms. Scheler,

Thanks you for including the ACHP in your notice for the Draft Feasibility Report and EA for Lake Worth Lagoon Project. Should the Army Corps of Engineers, through consultation with the FL SHPO, tribes, and other consulting parties, alter its current determination from that of no effect to historic properties to that of an adverse effect, please invite the ACHP to participate at that time, pursuant to our regulations 36CFR800.6(a)(1).

Sincerely,

Christopher Daniel
Program Analyst
Advisory Council on Historic Preservation
202.517.0223 (Office & Mobile)
cdaniel@achp.gov

Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington DC 20001-2637
(202) 517-0200 (Main Number)

Appendix E – Monitoring and Adaptive Management Plan
Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) Project

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1 PURPOSE

Section 2039¹ of Water Resources Development Act (WRDA) 2007 directs the Secretary of the Army to ensure, that when conducting a feasibility study for a project (or component of a project) under the U.S. Army Corps of Engineers (USACE) ecosystem restoration mission, that the recommended project includes a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. An adaptive management plan is required by U.S. Army Corps of Engineers (USACE) implementation guidance for the Water Resources Development Act (WRDA) 2007 Section 2039². This monitoring and adaptive management plan will include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met. The plan provides strategies to address project uncertainties that will be faced as the project progresses toward achieving restoration goals and objectives while remaining within identified constraints. Each strategy follows a scientific approach that uses performance measures, monitoring, triggers and/or thresholds to inform restoration progress and support decisions regarding the need to adjust to improve restoration performance. This monitoring and adaptive management plan will be used for implementation of the Lake Worth Lagoon (LWL) 1135 Continuing Authorities Program (CAP) project, located on Florida's southeastern coast.

2 INTRODUCTION

Uncertainty exists in every natural resource management and restoration effort. Many processes in the ecosystem are not linear; they work synergistically and will unfold in a future climate that is likely different than the one used to formulate the initial plan. The monitoring and adaptive management plan will address key uncertainties identified during plan formulation that relate to achieving restoration success and making adjustments of project features and operations if determined to be necessary to improve performance.

Definitions that will help the reader in understanding the LWL 1135 CAP project monitoring and adaptive management plan include the following:

- **Adaptive Management** – A scientific process for continually improving management policies and practices by learning from their outcomes; Adaptive management links science to decision making to improve restoration performance, efficiency, and probability of success. In the context of the LWL 1135 CAP project, adaptive management is a structured approach for addressing uncertainties by testing hypotheses about the best project designs and operations to achieve restoration goals and objectives, linking science to decision making, and adjusting implementation, as necessary, to improve the probability of restoration success.

¹ Title 2, Water Resources Development Act of 2007 § 2039 (2007). <https://www.gpo.gov/fdsys/pkg/PLAW-110publ114/pdf/PLAW-110publ114.pdf>

² USACE, 2009. USACE HQ Implementation Guidance on Section 2039 of Water Resources Development Act. http://www.mvr.usace.army.mil/Portals/48/docs/Environmental/EMP/Key%20Docs/2007_Implementation_Guidance_WRDA07_Sec_2039.pdf

- **Uncertainty** – A question faced during planning or implementation regarding the best actions to achieve desired goals and objectives within constraints, which cannot be fully answered with available data or modeling.
- **Management Options** – Potential structural, non-structural, and operational alternatives to be undertaken to improve restoration performance. Adaptive management plans contain potential management action “options” that may be taken to improve performance if project/program goals and objectives are not met.
- **Strategies** – A plan to address one or more uncertainties identified. The adaptive management strategies fit into the following approaches:
 - *Passive Adaptive Management* (see **Figure E-1**) – All of the LWL 1135 CAP project strategies are considered passive adaptive management approaches. One project component or set of operational criteria is implemented to test its ability to achieve desired goals and objectives. Results are monitored, assessed, and communicated to implementing agencies and the appropriate participating agencies to determine how best to adjust project component designs, operations, project contingency options, or inform future environmental restoration projects.

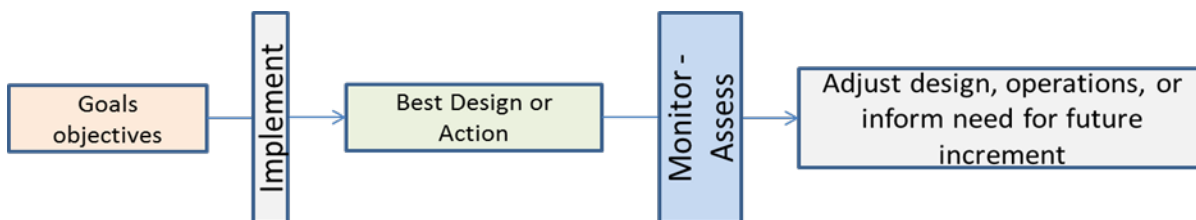


Figure E-1. Passive Adaptive Management.

Diagram illustrates that the best design or management action is implemented to achieve project goals and objectives with associated monitoring and results are assessed to adjust other project component designs, adjust operations and inform the need for a future project change.

Prior to development of this monitoring and adaptive management plan, existing monitoring from similar environmental restoration projects were evaluated to provide a frame of reference for the LWL 1135 CAP project. The monitoring recommended is what is needed beyond the other sources to address key uncertainties (key questions) identified during planning that relate to achieving project goals and objectives. Project specific adaptive management activities will be implemented as necessary in coordination with partner agency monitoring activities.

3 ADAPTIVE MANAGEMENT UNCERTAINTIES AND PROJECT OBJECTIVES

The uncertainties in this section target prioritized needs and opportunities to learn in order to make scientifically sound recommendations to refine the project design, construction, and operations. The strategies and management options provided in the following sections address each uncertainty and are intended to guide the LWL 1135 CAP project performance in the face of inevitable unknowns, with existing knowledge and knowledge that will be gained through monitoring and assessment. The strategies are focused on the LWL 1135 CAP project, but designed to contribute to future changes to environmental restoration projects as well in order to maximize ‘return on investment’ for resources invested in pursuing the adaptive management activities. The monitoring proposed was guided in part by two objectives: to be complete from a

LWL 1135 CAP project perspective by providing the monitoring required to address the project-specific uncertainties; and to integrate with other environmental monitoring to take advantage of existing monitoring efforts, knowledge and information and thereby leverage dollars committed and spent elsewhere to avoid redundancies and insure cost-effectiveness. *Where possible, the LWL 1135 CAP project adaptive management strategies rely on existing monitoring resources such as physical instrumentation, stations, locations, servicing and analysis efforts funded by partner agencies. Therefore, the monitoring requirements described here are limited to the additional, marginal increase in monitoring resources and analysis efforts needed to address LWL 1135 CAP project-specific adaptive management questions.*

3.1 Project Uncertainties

The project plans were reviewed to identify key uncertainties related to achieving project goals and objectives. The project objectives and constraints are outlined in LWL 1135 CAP project Management Measure Matrix and the project objectives are listed in **Table E-1**. The overarching objective of LWL 1135 CAP project is to re-establish biologically productive inter- and sub-tidal habitats lost to dredging and filling, increasing the acreage of benthic habitat whose productivity has been impeded by freshwater pulses and sediment loading from the C-51 canal, and to generally provide additional productive fish and wildlife habitat that is sustainable. The plan consists of constructing a series of mangrove islands with surrounding shallow seagrass recruitment areas, benthic infaunal habitat, mudflats, and oyster reefs.

Table E-1. LWL 1135 CAP Project Objectives

A.	Creation of seagrass habitat
B.	Creation of mangrove habitat
C.	Creation of oyster habitat

The uncertainties of the project implementation are listed here for reference.

1. *How will the LWL 1135 CAP project affect seagrasses in the project area?*
2. *How will the LWL 1135 CAP project affect the future occurrence of mangroves in the project area?*
3. *How will the LWL 1135 CAP project affect the future occurrence of oysters in the project area?*

4 PROJECT MONITORING AND ADAPTIVE MANAGEMENT STRATEGIES

Strategy descriptions for each uncertainty and summary tables of suggested management actions to improve restoration performance, as illustrated in **Table E-2**, are listed in this section. The following strategies describe and address each uncertainty and inform project implementation and operations based on the body of existing scientific knowledge. The strategy write-ups include information on drivers of the uncertainty, restoration targets, and project targets for particular attributes of the ecosystem associated with the uncertainty (such as a key species or ecological features). Additionally, the strategies include monitoring plans for each uncertainty, including how the attributes will be monitored to track progress toward the targets, the timeframe³ in which changes in these attributes will be measurable, and identification of a trigger or threshold that would give early warning that project performance is veering from restoration expectations. An annual summary report will be drafted to briefly summarize the monitoring data and other information collected to determine if adaptive management is needed. A final report will be drafted that details the outcomes of the restoration project.

Following the strategies, the suggested management options matrix (MOM) is provided. The matrix lists suggestions of paths forward and adjustments that can be made in order to keep the project progressing toward the targets, based on specific decision-criteria, e.g., a trigger or threshold is crossed (reflecting unintended effects related to a constraint) or is not crossed (reflecting lack of restoration progress towards restoration goals and objectives). The purpose of the two formats is to provide a background and detail of each strategy and a table reference summary and crosswalk that relates monitoring to specific decision-criteria and potential actions for multiple strategies in a specific area.

³ The “timeframe in which changes will be measurable” does not imply that changes will be *complete* in that timeframe; rather, the timeframes provide an estimate of time needed to *begin* to be able to distinguish effects. For practicality, the screening criteria included the need to have attributes measurable within the timeframe of the monitoring plan, which in some cases necessitated a ‘proxy’ attribute to be measured that would represent expected changes on a longer time scale. In addition, the triggers and thresholds were identified with the best available information, however, these should be updated to keep current with best available science.

Table E-2. LWL 1135 CAP Project Adaptive Management Strategies: Template and Definitions

<p>LWL 1135 CAP Project Adaptive Management Uncertainty. <i>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.</i></p> <p>LWL 1135 CAP Project Objective or Constraint. <i>Uncertainties need to be related to the project's objectives or constraints, among other criteria, to be included in the monitoring and adaptive management plan. This linkage focuses the scope of the Monitoring and adaptive management plan.</i></p> <p>Associated LWL 1135 CAP Project Features. <i>Structures or measures to which the uncertainty and strategy pertain.</i></p> <p>Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each. <i>A scientific approach begins with a well-informed, pointed, detailed statement that will be tested. For the purposes of the LWL 1135 CAP project's monitoring and adaptive management 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.</i></p> <p>Monitoring methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: <i>More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the LWL 1135 CAP project's monitoring and adaptive management plan varies in the level of methodology detail provided; methodology will be reviewed, updated and adjusted if needed by agency subject experts, before initiation, to best meet the intent of the monitoring and adaptive management plan.</i></p> <p>Triggers/thresholds that indicate good project performance or need for adaptive management action. <i>Triggers or thresholds are a point, range, or limit that signifies when restoration performance is veering away from expectations and is trending toward an unintended outcome. Triggers/thresholds should be described per attribute to be monitored because each should result in an outcome that informs management decisions.</i></p> <p>Management options that may be chosen based on test results. <i>Management Options are provided in case a performance trigger or threshold is crossed, which would indicate that the project performance needs to be adjusted. The Management Options are suggested paths forward and adjustments that can be made to keep the project progressing toward objectives and within constraints.</i></p>

4.1 Seagrasses

Seagrasses are important biological resources because they consolidate sediments, provide refuge and foraging habitat for fish, including juveniles and larvae, act as substrate for epiphytes and algae, provide feeding areas for birds and other wildlife, provide oxygen, take up nutrients, and act as a sink for carbon thus enhancing water quality. The creation of seagrass habitat is a primary goal of LWL 1135 CAP project.

LWL 1135 CAP Project Adaptive Management Uncertainty. *How will the LWL 1135 CAP project affect seagrasses in the project area?*

LWL 1135 CAP Project Objective or Constraint. This uncertainty is related to the LWL 1135 CAP project objective A (creation of seagrass habitat).

Associated LWL 1135 CAP Project Features. Seagrass recruitment is dynamic and can vary significantly depending on tidal conditions and wave energy. Freshwater pulses have the ability to depress productivity or even eliminate seagrasses for short periods. Seagrasses need a salinity range of 10-35 parts per thousand (ppt) to thrive.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. Establishment of seagrass beds in the LWL 1135 CAP project is expected to take approximately 2-4 years. Seagrass restoration projects in this area, specifically the Snook Islands restoration project, have been highly successful, therefore, it is expected that natural recruitment of seagrasses in the LWL 1135 CAP project area would also be successful. Following completion of island creation construction, annual monitoring will be performed to assess seagrass density and location (as percent covered) in the project area.

Monitoring methodology for testing each expectation or hypothesis. Seagrass monitoring for area covered and density will occur annually and during the months when seagrasses are most likely to be present. Monitoring will be performed via transect and quadrant measurements and can be performed by a contractor or Palm Beach County (PBC). Annual monitoring will continue until the LWL 1135 CAP project seagrass coverage and density goals are met.

Triggers/thresholds that indicate good performance or need for adaptive management action. The creation of seagrass habitat at the LWL 1135 CAP project will be deemed successful when at least 30% or more of the potential seagrass recruitment area is covered by a density of 30% or more seagrasses for any 2 annual monitoring periods. If no presence of seagrasses or a continued reduction in the percent coverage or density of seagrasses within the potential recruitment area is consecutively documented, adaptive management options should be considered.

Management options that may be chosen based on results. Based on the achieved results at the nearby Snook Islands restoration project, natural recruitment of seagrasses at LWL 1135 CAP project is expected to be successful. Should natural recruitment fail, seagrass transplanting should be considered. This adaptive management strategies are not preferable due to higher costs and historically lower success rates.

4.2 Mangroves

Mangrove forests serve important functions in the ecology of the LWL. They recycle nutrients and promote the nutrient mass balance of estuarine ecosystems. Mangrove leaves, wood, roots, and detrital material provide essential food chain resources, and provide habitat for refuge and foraging habitat for various wildlife and fish, including juveniles and larvae. Mangroves also serve as storm buffers, stabilizing shorelines and fine substrates with their roots, thereby reducing potential turbidity and enhancing water clarity. The creation of mangrove habitat is a primary goal of LWL 1135 CAP project.

LWL 1135 CAP Project Adaptive Management Uncertainty. *How will LWL 1135 CAP project affect the future occurrence of mangroves in the project area?*

LWL 1135 CAP Project Objective or Constraint. This uncertainty is related to LWL 1135 CAP project objective B (creation of mangrove habitat).

Associated LWL 1135 CAP Project Features. Mangroves are hearty, robust plants that are able to easily survive in estuarine conditions given the right elevations.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. Establishment of mangroves in LWL 1135 CAP PROJECT is expected to take approximately one year following planting. Based on the results of the nearby Snook Islands restoration project, planting of mangroves is expected to be successful. Annual monitoring will be conducted annually after the planting of the mangroves to assess and document survivability.

Monitoring methodology for testing each expectation or hypothesis. Monitoring for planted mangrove survivability will occur annually with a crew of two people and one vessel. Monitoring can be performed by a contractor or PBC. Annual monitoring will continue until the LWL 1135 CAP project mangrove survivability goal is met.

Triggers/thresholds that indicate good project performance or need for adaptive management action. The creation of mangrove habitat at the LWL 1135 CAP project will be deemed successful when at least 80% of the planted mangroves survive for two consecutive annual monitoring events. If less than 80% of the planted mangroves survive, adaptive management options should be considered.

Management options that may be chosen based on results. Survival of mangroves at LWL 1135 CAP project is expected due to the success of mangrove planting at the nearby Snook Islands restoration project. Should the project fail to reach an 80% or more survival rate of the planted mangroves during monitoring events, additional plantings should be conducted until at least an 80% survival rate is achieved for two consecutive annual monitoring events.

4.3 Oysters

Oysters provide numerous ecological benefits including habitat diversity, erosion control, and improvement of water quality. Oysters consolidate sediments, provide foraging habitat for wildlife and fish, act as substrate for epiphytes and algae, and improve water quality by filtering nutrients and particulate matter out of the water column. The creation of oyster habitat is a primary goal of LWL 1135 CAP project.

LWL 1135 CAP Project Adaptive Management Uncertainty. *How will LWL 1135 CAP project affect the future occurrence of oysters in the area?*

LWL 1135 CAP PROJECT Objective or Constraint. This uncertainty is related to LWL 1135 CAP project objective C (creation of oyster habitat).

Associated LWL 1135 CAP PROJECT Features. Studies completed at the nearby Snook Islands compare naturally occurring oyster densities, reproduction, and mortality with restoration oysters. These studies show similar success between natural and restored oyster habitat.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. Natural recruitment of oysters in LWL 1135 CAP project is expected to take approximately one to two years following the placement of suitable oyster substrate. Based on the results of the nearby Snook Islands restoration project, the creation of oyster habitat at LWL 1135 CAP project is expected to result in successful natural oyster recruitment. Following the placement of suitable oyster substrate, annual monitoring will be performed to assess oyster recruitment, density, and survivability.

Monitoring methodology for testing each expectation or hypothesis. Oyster monitoring to document recruitment, density, and survivability will occur annually and during the months when the release of spat is likely to take place. Monitoring will be performed via shell string survey and sampling. The monitoring could be performed by a contractor or PBC. Annual monitoring will continue until the LWL 1135 CAP project oyster recruitment goal is met.

Triggers/thresholds that indicate good project performance or need for adaptive management action: The creation of oyster habitat at the LWL 1135 CAP project will be deemed successful when live oysters are documented on the placed substrate for two consecutive annual monitoring events. If no presence of oysters or no live oysters are consecutively documented on the placed substrate, adaptive management options should be considered.

Management options that may be chosen to facilitate establishment of oysters. Based on the achieved results at the nearby Snook Islands restoration project, natural recruitment of oysters at LWL 1135 CAP project is expected to be successful. Placement of spat on shell is an adaptive management strategy that could be considered if natural recruitment fails. Implementation of this options should be considered if no presence of oysters or no live oysters are consecutively documented in the LWL 1135 CAP project.

5 MANAGEMENT OPTION MATRIX

The Management Option Matrix (MOM) (see **Table E-3** below) helps link monitoring to decision criteria and suggested management options to consider for adjusting the project if monitoring reveals performance issues related to project operations. The management options included in the LWL 1135 CAP project monitoring and adaptive management plan can be described as the following:

1. *Informing LWL 1135 CAP Project Implementation-* Results of monitoring a project component may inform next phase of project component construction sequencing,
2. *Inform Project Operations-* Results inform project operations or system operating manuals,
3. *LWL 1135 CAP Project Adaptive Management Contingency Options-* Monitoring results may suggest a need to implement additional restoration actions, called adaptive management options, pending all required and applicable coordination, policies, and permitting.

The MOM is a quick reference intended to inform decision-makers, partner agencies, and the public on potential actions to improve restoration performance. ***Implementation of adaptive management options is not automatic; the options are suggestions that capture current understanding of potential future issues and solutions. While the monitoring and adaptive management plan and its suggested options are considered part of the recommended plan, all applicable policies, permitting, and coordination requirements apply to implementing adaptive management options.***

Table E-3. LWL 1135 CAP Project Management Options Matrix (MOM)

Uncertainty	Timeframe to detect change of attributes*	Attribute or Indicator	Specific Property to be Measured and Frequency	Decision Criteria Trigger(s) for Management Action	Management Action Option(s)
Seagrasses	2-4 years	Seagrasses	Annual monitoring of potential recruitment area for percent covered by seagrasses and density of seagrasses	Less than 30% of recruitment area is covered at 30% density after 4 years following project construction completion	Seagrass transplanting
Mangroves	1 year	Mangroves	Annual monitoring of planted mangrove survivability	Less than 80% of the planted mangroves survive	Plant additional mangroves
Oyster reefs	1-2 years	Oysters	Annual monitoring of oyster recruitment, density, and survivability	No oyster or no live oysters	Placement of spat on shell

*The “timeframe to detect changes...” does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of LWL 1135 CAP project. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.

5.1 Monitoring Costs and Adaptive Management Strategies

Adaptive management options and monitoring frequency for LWL 1135 CAP project are captured within Table E-3. Costs in **Table E-4** were based upon previously completed and similarly scoped restoration projects.

Table E-4. LWL 1135 CAP Project Monitoring Costs

Uncertainty	Management Action Option	Management Action Option Cost
Seagrasses	Natural recruitment	\$0.00
Seagrasses	Monitoring	\$17,000.00 (annual)
Mangroves	Plant mangroves	\$0.00 ⁴
Mangroves	Monitoring	\$5,000.00 (annual)
Mangroves	Plant additional mangroves to meet 80% survivability goal	\$2.00 per plant
Oysters	Natural recruitment	\$0.00
Oysters	Monitoring	\$5,000.00 (annual)

⁴ 8 acres of mangroves are being provided by PBC.

APPENDIX F
Pertinent Correspondence

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP)
SECTION 1135, PROJECT

DRAFT INTEGRATED FEASIBILITY
REPORT
AND ENVIRONMENTAL
ASSESSMENT

December 2017



**US Army Corps
of Engineers**®
Jacksonville District



Department of Environmental
 Resources Management
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**Palm Beach County
 Board of County
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Paulette Burdick, Vice Mayor

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Shelley Vana

Steven L. Abrams

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County Administrator
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*"An Equal Opportunity
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ATTACHMENT 1

April 1, 2014

Tim Murphy
 Deputy Chief Operations Branch
 U.S. Army Corps of Engineers Jacksonville District
 701 San Marco Blvd.
 Jacksonville, FL 32207

**SUBJECT: PROJECT MODIFICATIONS IN PALM BEACH COUNTY,
 FLORIDA THROUGH WRDA, SECTION 1135**

Dear Mr. Murphy:

In accordance with the provisions of Section 1135(b) of the Water Resources Development Act of 1986, as amended, which authorizes the Federal government to initiate investigations and studies to be made in the interest of water resources development, Palm Beach County hereby makes formal application for a study of a modification to an existing Corps project or its operation of the Atlantic Intracoastal Waterway (AIW) and Palm Beach Harbor Navigation Project (PBHNP) in Palm Beach County, Florida for the purpose of improving environmental quality.

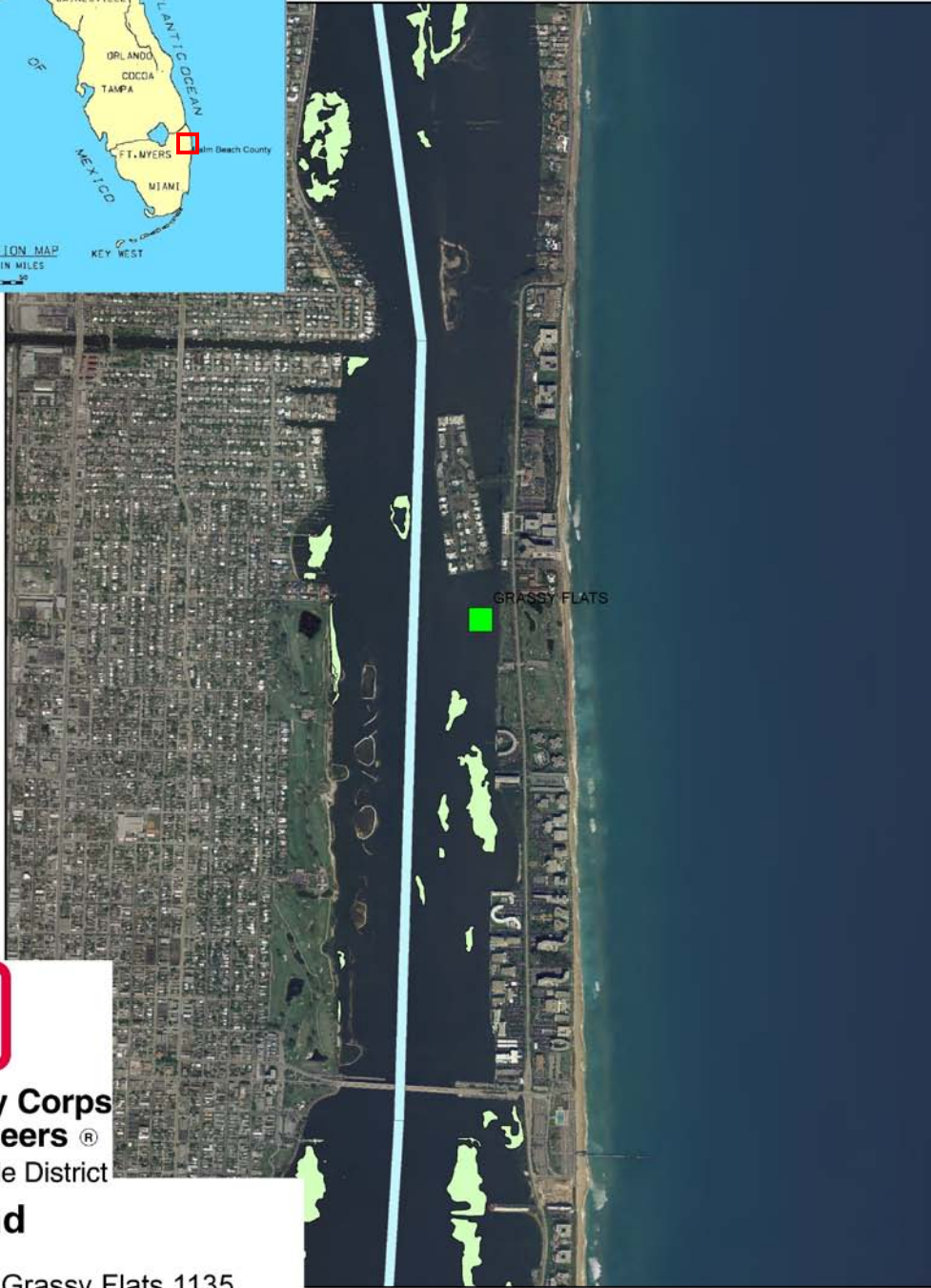
The proposed modification will restore seagrass, mangrove and oyster habitats within the Lake Worth Lagoon Estuary. These resources have been lost due to dredging and filling activities associated with the AIW and PBHNP.

It is Palm Beach County's understanding that if an Initial Appraisal Report, prepared at Federal expense, indicates that the proposed modifications have merit; feasibility level studies would be initiated. The subsequent Feasibility Report would be initially funded by the Corps of Engineers, but will be considered part of the total project cost.

Palm Beach County is a proven local sponsor with a track record of successfully completing major restoration projects in partnership with the Corps through Section 1135: Munyon Island, John's Island, Peanut Island and Snook Islands. We look forward to partnering again, with the Corps, to further restore the Lake Worth Lagoon.

Sincerely,

Daniel Bates, Deputy Director
 Environmental Resources Management



**US Army Corps
of Engineers** ®
Jacksonville District

Legend

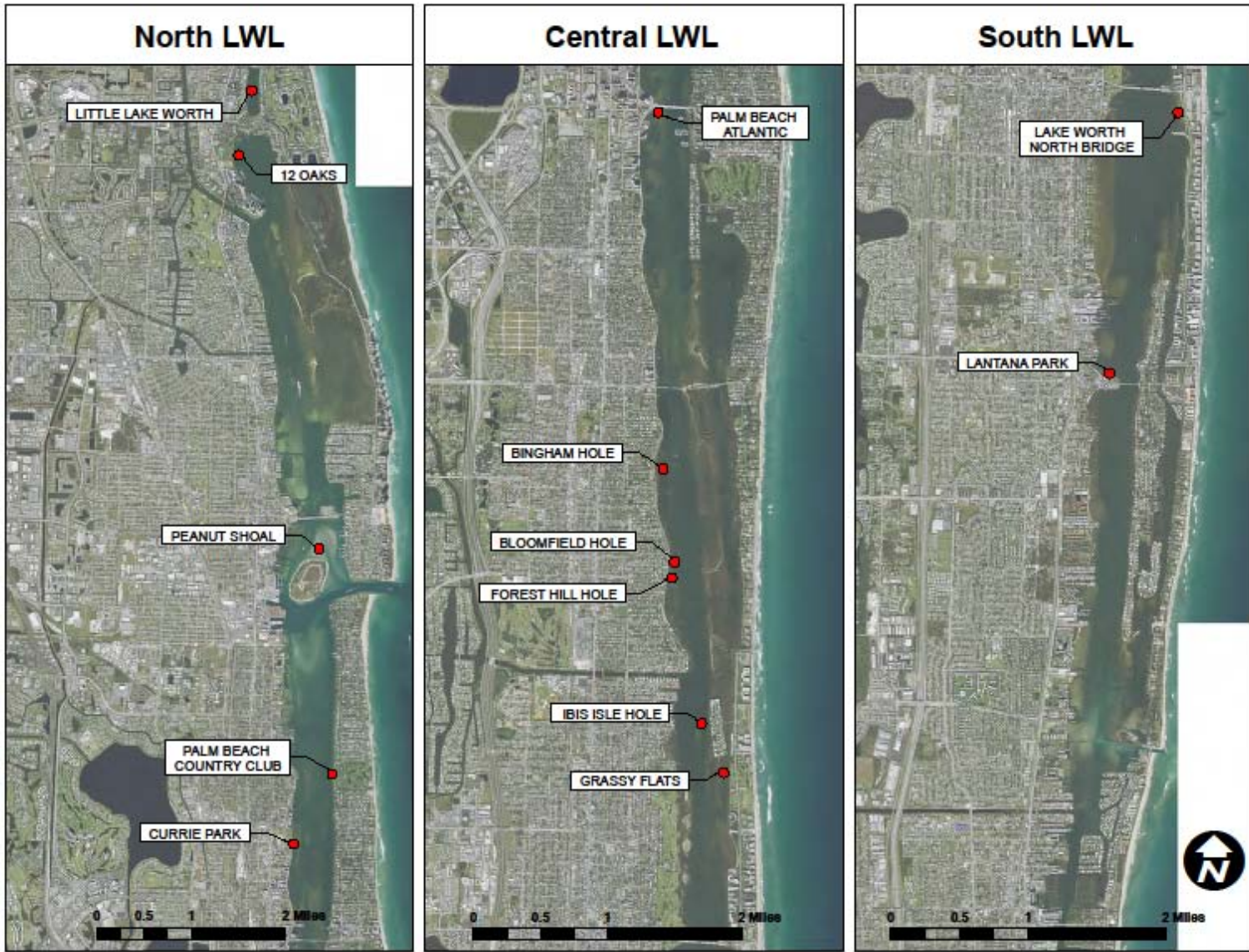
- Grassy Flats 1135
- FMRI Seagrass 87-07
- ICW



MAP 1



MAP 2



MAP 3



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

21 JUL 2017 1

CESAJ-PD

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, South Atlantic Division (CESAD-PDP, Mr. Eric Bush), 60 Forsyth Street, Room 10M15, Atlanta, GA 30303

SUBJECT: MSC Decision Milestone (MDM) for the Lake Worth Continuing Authorities Program (CAP) Section 1135 Feasibility Study and Environmental Assessment

1. Purpose: This memorandum outlines key discussion and decisions made at the November 02nd, 2016 MDM meeting held for the subject project.

2. Meeting Attendees:

a. SAJ: Dave Tipple, Kevin Wittman, Gina Ralph, Dave Apple, Dan Vogler, Jeff Fallin, Jim Suggs, Jim Lagrone, Rafael Torress Pagen, Carlos Cepero, Brittany Berger, Jeff Bergen, Mike Renecker, Andy Loschiavo, Marc Tiemann, Dan Abecassis, Drew Coman, Russ Weeks, Matt Cunningham, Jason Engle, Melissa Reynolds, Patrice Morey, Dr. Jennifer Coor, Brooke Hall, Kevin Hodgens, Kelci Mynhier, and Jerome Morgan.

b. SAD: Kenitra Stewart, Patrick O'Donnell, Debbie Scerno, Vivian Davis, Kellie Tyler, and Eric Bush.

c. Palm Beach County (non-federal sponsor): Dan Bates, Julie Bishop and Dave Carson.

3. Background:

a. The authority for conducting this feasibility study is the Continuing Authorities Program (CAP), Section 1135 of the Water Resource Developmental Act (WRDA) of 1986, as amended, "Project modifications for the improvement of the environment." The Federal Interest Determination (FID) was approved on March 25th, 2015.

b. The study area is located within Lake Worth Lagoon (LWL) in Palm Beach County, Florida. Lake Worth Lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Palm Beach Island and Singer Island. It is approximately 20 miles long and up to one mile wide. The Lake Worth Inlet connects the northern part of the lagoon to the ocean and is the entrance channel to the Port of

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SUBJECT: MSC Decision Milestone (MDM) for the Lake Worth Continuing Authorities Program (CAP) Section 1135 Feasibility Study and Environmental Assessment

Palm Beach. South Lake Worth Inlet (also known as Boynton Inlet connects the southern part of the lagoon to the ocean and is primarily used by recreational boaters. The Intracoastal

c. Waterway (IWW) runs the entire length of the lagoon. Eight causeways and bridges connect the mainland to the barrier islands.

d. It is recognized that past USACE dredging and filling activities have been previously addressed by construction of Peanut and Snook Islands in northern LWL, so the CAP LWL 1135 will focus on potential ecological solutions that can withstand impacts of the C&SF project freshwater deliveries via Canals 16, 17 and C-51. Due to Federal dredging and filling activities associated with the Intracoastal Waterway (IWW) and Palm Beach Harbor Navigation Project (PBHNP), Lake Worth Lagoon has encountered severe losses in seagrass, mangrove, and oyster habitat. The loss of habitat has also been exacerbated, if not directly caused, by discharges from Canals C-16, C-17 and C-51 which were constructed by the U.S. Army Corps of Engineers (USACE) in the 1980s as part of the Central and Southern Florida (C&SF) regional water management system and subsequently turned over to the South Florida Water Management District (SFWMD) for operation and maintenance. Discharges from these canals to the Lagoon provide flood damage reduction benefits for the upland urban and agricultural areas within the drainage area. It is understood that these flood discharges, particularly from C-51, sometimes have sufficient freshwater volume to temporarily reduce the salinity in the lagoon with potential negative impacts on the marine ecosystem. In addition, these canal discharges transport fine grained sediment (muck) and attached nutrients (nitrogen and phosphorous) to the lagoon where they may contribute to water clarity, sedimentation and algae bloom problems in the lagoon.

e. While the CAP Lake Worth Lagoon 1135 project cannot prevent future activities which may continue to cause impacts similar to those observed and discussed in the problems identified above, the 1135 can create a project that withstands the conditions and still has an environmental restoration benefit that is viable and sustainable.

f. The Recommended Plan consists of an approximate 50 ac eco-island chain at the Bonefish Cove dredge sit in Lake Worth Lagoon. The eco-islands will consist of approximately 345,000 yards of material from the Peanut Island Dredge Disposal Management Area. This island will be built on a 1:8 slope providing ~ 26 acres of SAV habitat that is sustainable in the current and future Lake Worth environment of changing salinities and muck accumulation. 8 acres of mangroves will be planted and 1 acre of oyster habitat will be created as part of the eco-island chain. This complex ecosystem

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will provide suitable habitat to invertebrates/juvenile fishes, infauna/benthic organisms and migratory birds as well.

4. MDM Key Decisions:

a. Agreement on the following decisions was reached during, or as a result of coordination following, the MDM.

(1) SAD endorsement of the proposed Recommended Plan. The Recommended Plan was confirmed to be technically feasible and policy compliant.

(2) The Recommended Plan can be release for public comment following District Quality Control (DQC) and Agency Technical Review (ATR).

(3) SAD requests SAD review start at same time as ATR, concurrent (feasibility study)

(4) Since concurrent reviews are being utilized DQC is even more important

(5) Environmental consolation should proceed without further delay to include informal communication with the resource agencies, Biscayne Bay River Keeper, Florida Department of Environment and Natural Resources and National Marine Fisheries Service in advance of release for public comment.

(6) SAD requested an estimate of construction time for the Recommended Plan. Currently, the estimated construction time is eighteen (18) months.

(7) A public meeting will be held for the Recommended Plan to gauge the interest of the public. This meeting is slated to occur in the third week of January, 2017.

5. Comments and Conclusions:

a. The following are additional comments discussed at the meeting:

(1) Comment: What is the source of the water flowing through structure if it isn't runoff? Discharges aren't from local. 75% are from S155, 10% from Lake O. Clarify in MFR, Runoff from Lake O vs local runoff along C51.

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(2) Conclusion: There are seven drainage basins comprising the LWL watershed: L-8, STA-1E, C-17, C-51, C-16, and Lake Worth Lagoon basin with a total of 478.45 square miles. The C-51-East basin, directly head-ward of the S-155 structure is 73.46 sq. mi. and is also the most developed basin within the LWL watershed. Freshwater discharges to Lake Worth Lagoon from the Federal Central & Southern Florida (C&SF) project result in negative impacts on seagrass, benthic organisms (oysters, worms, etc.), and other features of the marine ecosystem by inducing sudden changes from brackish to low salinity conditions, which can last hours or days. These discharges also deliver fine-grained sediments and muck, gradually covering the natural sands and hard bottom of the lagoon floor (diminishing productivity and eventually producing mortality) in seagrass and benthic organisms. C-51 is part of the C-51 Flood Control Project. CESAJ moves water through C-10A to get water out of Lake Okeechobee (LO), which flows into C-51 through S-5AE. However, per SAJ Operations, it is a complex question to determine the amount of LO water that makes it all the way to LWL. Releases from LO via L-8 are typically used by the SFWMD to replenish the L-8 reservoir.

(3) Comment: How is sedimentation and fresh water pulses being addressed in this project?

(4) Conclusion: Sedimentation and freshwater pulses are not being addressed in this project. Solutions such as C-51 Phase I & II reservoirs are being built by the local sponsor to alleviate freshwater flows to LWL. While the CAP Lake Worth Lagoon 1135 project cannot prevent future activities which may continue to cause impacts similar to those observed and discussed in the problems identified above, the 1135 can create a project that withstands the conditions and still has an environmental restoration benefit that is viable and sustainable.

(5) Comment: What contributes to decline in FWOP? Slide 20.

(6) Conclusion: All alternatives were assigned HSI scores for existing (EX), future without project (FWO), and future with project (FWP) conditions. It was assumed that the habitable environment in the FWO condition would degrade linearly for each project site based continued muck accumulation. That assumption was also used when assigning FWP scores for Alternatives 2A and 2B because the flat-sloped design would not help prevent continued muck accumulation, unlike Alternatives 1A and 1B which would limit sedimentation and create habitat more capable to adapt to sea level rise.

(7) Comment: Adaptive management plan costs?

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(8) Conclusion: We have established cost for monitoring and adaptive management. Typical tasks for monitoring include:

b. Seagrass transect sampling – Based on the achieved results at the nearby Snook Islands restoration project, natural recruitment of seagrasses at Bonefish Cove is expected to be successful. Seagrass recruitment will be deemed successful when at least 30% or more of the potential seagrass recruitment area is covered by a density of 30% or more seagrasses for any 2 annual monitoring periods. Should natural recruitment fail, seagrass transplanting is also an adaptive management strategy, however, this option is less preferred due to higher costs and historically lower success rates. Implementation of transplanting should be considered if no growth is consecutively documented at Bonefish. Annual surveys will include costs for 1 vessel and two teams of two. Estimated manpower needed is 5-8 days total field work at an annual cost of \$17,000.

c. Mangrove monitoring – Survival of mangroves at Bonefish is expected due to the success of mangrove planting at the nearby Snook Islands restoration project. Should mangroves fail to reach an 80% or more survival rate during monitoring events, additional plantings will be conducted until at least 80% survival rate is achieved for two consecutive annual monitoring events. Typical manpower estimates for mangrove planting in the LWL area have needed a crew of 4 for re-planting at a cost of \$2 per tree for mangroves. Annual surveys will include costs for 1 vessel and a crew of two. Estimated manpower needed is 2-3 days total field work at a cost of \$5,000.

d. Oyster monitoring – Based on the achieved results at the nearby Snook Islands restoration project, natural recruitment of oysters is expected to be successful. Placement of seeded oyster substrate or spat transplanting are additional adaptive management strategies that could be considered if natural recruitment fails. These options are less preferred due to higher costs. Implementation of these options should be considered if no recruitment is consecutively documented. An annual shell string survey and substrate sampling would take 2-3 days of total field work at a cost of \$5,000.

6. Project will be monitored until success criteria are met.

a. Comment: Follow up with O&M not being allowed from requirements.

b. Conclusion: For Section 1135 projects, the costs of OMRR&R are a 100 percent non-Federal responsibility and the work is usually performed by the non-Federal sponsor. The PDT has strived to create sustainable solutions that minimize OMRR&R costs.

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c. Comment: Erosion from small boat wave action needs to be removed from objective.

d. Conclusion: It has been removed.

e. Comment: Combine or clarify IWW – Temporary construction constraint vs permanent. The temporary construction and permanent IWW constraint is 100 feet from right of way.

f. Conclusion: The PDT does foresee this project encroaching no closer than 150 feet from the IWW right of way for construction of the permanent solution.

g. Comment: Clarify “offloading DMMA’s” constraints

h. Conclusion: The construction method is based on the previous project conducted in Lake Worth Lagoon area.

7. The material will be excavated from Peanut Island DMMA and transported to the shore and loaded in a barge with a conveyor. Equipment use at the island will be Heavy Equipment only.

8. The loaded material will be transported in from Peanut Island to the final destination 11.8 miles away through the lagoon.

9. Equipment and crew cost were extracted from CEDEP.
CESAJ-PD

10. The material will unloaded at “Bonefish” area with an excavator in a flat barge. The excavator will load the pump to the final delivery.

11. Any damage done to the structural integrity of the DMMA dike structure will need to be repaired at the contractor’s expense to the original design for future offloading.

a. Comment: From Senior SAD Planner Debbie Scerno– Will SAJ maintain dikes, or take material from dike? Clarify

b. Conclusion: See answer to (8).

c. Comment: Issues with muck salinity, water quality, clarify that it’s sufficient for project to survive.

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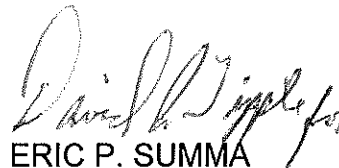
d. Conclusion: Island creation projects in LWL have raised the selected areas within the lagoon to inter-tidal elevations to avoid the reoccurring problem of the infilling of aquatic vegetation and established marine life due to submerged muck waves. Scarpa and Laramore (2010) measured and compared the growth, abundance, reproductive effort, and health of the Eastern Oyster (*Crassostrea virginica*) at three of DERM's projects:

(1) MacArthur, Ibis Isle, and Snook Island.

(2) Scarpa et al, quantatively concluded that LWL is a productive system with patches of healthy oyster populations that can be expanded by providing substrate and relying on natural recruitment.

(3) Project will be monitored until success criteria are met.

12. SAD endorsed the Recommended Plan and approved the path forward review and completion of the study. Submission of the draft report for SAD review is scheduled for 07Dec16.



ERIC P. SUMMA

Chief, Planning and Policy Division

District Quality Control

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017



**US Army Corps
of Engineers**®
Jacksonville District

COMPLETION OF DISTRICT QUALITY CONTROL

Final District Quality Control (DQC) of **The Lake Worth Lagoon 1135 CAP Integrated Feasibility Report and EA** has been completed per direction of EC 1165-2-209. All concerns resulting from the DQC review of the project have been mutually resolved and comments incorporated.

SIGNATURE

Dan Vogler
Study Manager (PTL)
[PD-PW]

Date _____

SIGNATURE

Jim Suggs
Project Manager (PM)
[PM-WM]

Date _____

SIGNATURE

James LaGrone
Engineer Technical Manager (ETL)
[EN-DW]

Date _____

SIGNATURE

Jim Suggs
CAP Program Manager
[PM-WN]

Date _____

CERTIFICATION OF DISTRICT QUALITY CONTROL

There were no critical comments resulting from the Final DQC. As noted above, all concerns resulting from the DQC of the project have been fully resolved.

SIGNATURE

Eric Summa
Chief, Planning Division (*home district*)
[PD]

Date _____

SIGNATURE

Lauren Borocharner
Chief, Engineering Division (*home district*)
[EN]

Date _____

Add appropriate additional signatures (Branch Chiefs, EN, PD, RE, principal for DQC, etc.).

SIGNATURE

Dennis Zeveney

Chief, Geotechnical Engineering
Branch
[EN-G]

Date _____

SIGNATURE

Jason Engle

Chief, Water Resources Engineering
Branch
[EN-W]

Date _____

SIGNATURE

David Dudley

Chief, Design Engineering Branch
[EN-D]

Date _____

ACTING

SIGNATURE

Kim Brooks-Hall

Chief, Engineering Technical
Services Branch
[EN-T]

FOR:

Date _____

SIGNATURE

Mike Renacker

Chief, Watershed Resources Branch
[PM-W]

Date _____

SIGNATURE

Dave Tipple

Chief, Plan Formulation Branch
[PD-P]

Date _____

SIGNATURE

Gina Ralph

Chief, Environmental Branch
[PD-E]

Date _____

SIGNATURE

Kevin Wittman

Chief, SAD Regional Economics
[PD-D]

Date _____

SIGNATURE

Tori White

Chief, Real Estate
[RE]

Date _____

SIGNATURE

Melissa Reynolds

CAP Engineering Lead
[EN-WH]

Date _____

SIGNATURE

Dan Vogler

CAP Planning Lead
[PD-PW]

Date _____

COMPLETION OF DISTRICT QUALITY CONTROL

District Quality Control (DQC) of **Lake Worth Lagoon CAP 1135 Project** has been completed per direction of EC 1165-2-209. All concerns resulting from the DQC review of the project have been mutually resolved and comments incorporated.

Dan Vogler
Study Manager (PTL)
CESAJ-PD-PW

Date _____

Jeff Fallin
Project Manager
CESAJ-PM-W

Date _____

James LaGrone
Engineer Project Manager (ETL)
CESAJ-EN-DW

Date _____

Jim Suggs
CAP Program Manager
CESAJ-PM-P

Date _____

CERTIFICATION OF DISTRICT QUALITY CONTROL

Significant concerns and the explanation of the resolution are as follows:

Plan Formulation

1. Remove "No action" from the management measure list, as it is an alternative.

RESPONSE: Concur. "No action: has been removed as a management measure.

2. Add a "Conclusion and Recommendation" section to the Executive Summary

RESPONSE: Text has been added to the Executive Summary.

3. Section 2.2.4: Sea level rise is 100 years, so need to address this.

RESPONSE: Expected sea level rise up to 100 years (2119) has been added to the report.

4. Need to provide an explanation of Figure 2-9 and how it relates to this project. Do we have a measurement or numerical numbers to back up this statement?

RESPONSE: Concur. Text was added to add more information to the relevancy of the figure and is consistent with the Engineering Appendix.

5. Section 2.4.8. Are we sure of this?

RESPONSE: Section 3.5.8.8 discusses the basis of the statement that there are no known hazardous or toxic materials within the project area.

Environmental

6. There needs to be a draft FONSI included after the title page.

RESPONSE: Concur. A draft FONSI has been added to the beginning of the report.

7. Section 2.4: Need to add a section on Native Americans.

RESPONSE: Concur. The Native American section is now in 2.4.9.

8. Page ES-13: Coordination with Agencies and the public section needs significant revision.

RESPONSE: Concur. Section has been significantly revised.

Engineering

9. Page ES-8 implies Snook Islands are located in north LWL (they are in central) and were constructed to offset impacts from USACE dredging and filling activities

- a. It was created by the County to fill in a dredge hole that was created when building the adjacent golf course.

RESPONSE: Concur. Removed Snook Islands from Section 1.5.3 as it is not a federal project

10. Which management measures were carried forward in the alternative development – hard to determine

RESPONSE: The management measures used for each alternative are clearly defined in Sections 3.5.2, 3.5.3, 3.5.4, and 3.5.5.

11. The project area section (page 1-1) does not mention the barrier island on the east side of the lagoon, and includes geological information which differs from the EN appendix – verify the information included is correct, as it does not agree with the literature – See Randazzo and Jones 1997.

RESPONSE: Concur. Reworded Section 1.3 to be consistent with EN appendix.

12. Section 1.5.3 – Peanut Island was NOT created in 2005 – it was created in 1918, and underwent an eco-restoration project by the County in 2005 to create a lagoon, etc. See EN appendix.

RESPONSE: Concur. Clarified original construction date and year of restoration in the text.

13. 2.2.2 Should have a reference for the sedimentation rate, as it is not included in the EN appendix.

RESPONSE: Do Not Concur. According to Trefry, Trocine, & Bennett (2009), the sedimentation rate in LWL is ~0.4-0.5 cm/yr (based on cores L38 and L55. Citation has been added to the text.

14. It appears sections 2.5.1 and 2.5.2 are missing (no text)

RESPONSE: Concur. Text has been added to these sections.

15. 3.5.6 – clarify that the material from the DMMA is acceptable, good quality sand. The “flat slope” is due to the sand capping method, not the sand grains being incapable of holding a slope in the water.

RESPONSE: Text was added to the second bullet that clarifies material from the Peanut Island DMMA is suitable.

16. Figure 3-5 shows different potential project sites than those vetted in the EN appendix.

RESPONSE: Concur. Figure 3-5 has been replaced with a new figure that is consistent with EN appendix.

17. Section 3.5.9.1.1 Habitat Suitability Indices discusses the existing site parameters and existing substrate, but does not include the muck thickness reported in the EN appendix at these locations, only reported the percent coverage as determined through a survey that was not ground truthed.

Engineering (contd.)

RESPONSE: Kept existing information, but results from the sediment probe data collection have been added to this section and is now consistent with the Engineering Appendix.

18. It appears sections 4.1.1 and 4.1.2 are missing (no text)

RESPONSE: Removed section 4.1.1 (General Description) because the description is listed under section 4.1. In addition, section 4.1.2 (Engineering Analysis) was also removed. Text was added referencing the engineering appendix for further analysis.

19. It appears the “work in kind” and “permits” sections in 4.1.3 are missing text

- a. The real estate figure does not seem accurate and the legend is too small to be read. The project will likely utilize both the FIND and Port DMMA’s – only half of the FIND DMMA is shown on the map.

RESPONSE: Text has been added to the WIK and Permits sections. The Real Estate figure has been replaced with a higher resolution image.

20. Section 5.6 – need to populate “Coral Reef Protection” and “Invasive Species” sections

RESPONSE: Concur. Sections with corresponding text were added.

21. Page 31 12/12/2016 2:59:51 PM

This supposed to be empty?

RESPONSE: Missing text has been added to the socio-economic section.

22. Page 13 12/15.2016 10:30:30 AM

The locations of C-17, C-16, and S-155 in this map are not accurate at all. Please fix.

RESPONSE: Concur. Figures have been updated throughout report with correct canal locations.

23. Page 9 12/15/2016 10:25:58

There is no discussion in the previous paragraphs (or anywhere that I can find in the main report) describing what or where S-155 is in relation to LWL and C-51 (other than a map with an incorrect location). Seems like there needs to be a better description of S-155 other than all the way in the engineering appendix. It is not clear that S-155 is synonymous with C-51.

RESPONSE: Concur. Text has been added to Section 2.2.1 and 2.4.4 that clarifies the relationship between C-51 and S-155.

24. Page 21, section 2.2.1. The EN appendix inflow analysis used surface water inflow data from DBHYDRO, and therefore the numbers are much different. Inflow numbers from the EN appendix should be used here to maintain consistency. Section 3.1.3.

RESPONSE: Concur. Section has been updated to reflect numbers from Engineering Appendix.

25. Page 2-7, Section 2.2.3. Reference? EN appendix discussed rainfall statistics by wet and dry seasons. Should use numbers from EN Appendix to maintain consistency. Section 2.3.1.

RESPONSE: Concur. Updated section using data from the Engineering Appendix.

26. Page 2-8, Section 2.2.4. The analysis in the EN appendix is completely different; had to use a different gage per guidance. Please use data from EN Appendix to maintain consistency. Word file to be sent separately.

RESPONSE: Concur. Updated section using data from the Engineering Appendix.

27. Page 3-7, Section 3.5.6. Please list the four by name: Currie Park, Tarpon Flats, Snook East, and Bryant Park.

RESPONSE: Correct project site names have been added.

Engineering (contd.)

28. Page 3-7, Section 3.5.6. First Bullet. Use the descriptions in the EN appendix for consistency. Section 4.3.7.

RESPONSE: Section has been revised to include project site names that are in the Engineering Appendix.

29. Page 3-7, Section 3.5.6. Second Bullet. This should be re-worded to clarify that the muck capping was screened out.

RESPONSE: Concur. This section was re-worded to "Although the material used from the DMMA is suitable, the method of sand capping will result in a flat slope. The seagrass habitat created may not adapt to rising sea levels without additional material being placed on top of the existing substrate."

30. Page 3-8, Section 3.5.6. Third Bullet. Need clarification that no place to dewater muck, and hard to find disposal site for saline sediment.

RESPONSE: Concur. Reworded bullet to read: "Hydraulically dredging muck would require turbidity measures, along with a location to dewater and dispose the muck. It would likely be hard to acquire a disposal site for saline sediment under a limited CAP budget and would not provide substantial habitat lift."

31. Page 3-8, Section 3.5.6. Map. Use map from EN Appendix with the four named sites.

RESPONSE: Concur. Map added to maintain consistency with the Engineering Appendix.

32. Section 4.1 – need to populate the blank sections, and also reference the Adaptive Management Plan in Appendix E somewhere in the document.

RESPONSE: Concur. Text referring to the Adaptive Management Plan was added to the second bullet of Section 3.5.6 and Table 4-1.

33. Page 4-6, Section 4.4. This is completely different from the EN Appendix. Different gage was required to be used, and therefore different SLC numbers. Please use text from EN Appendix.

RESPONSE: Concur. This section has been updated to be consistent with the Engineering Appendix.

34. Rafael Torres-Pagan provided his comments to you separately.

RESPONSE: Please see the section below for comment responses related to costs.

Cost Engineering

35. Table 3-5, Cost Effective Analysis for Initial Array of Alternatives displays Rough Order of Magnitude (ROM) Costs for Alternatives 1A, 2A, 1B, and 2B in ranking order of increased cost. Table 3-6, Incremental Cost Analysis, displays the two Best Buy Plans, 1A and 1B for Incremental Cost analysis, also using ROM level costs. It is noted that Alts 1A and 1B have been estimated using MCACES level costs (Engineering Appendix). It is recommended that Table 3-6, for the final array be revised to reflect the MCACES level cost estimate.

RESPONSE: Concur. At the time of the initial draft report, only ROM level costs were available for the final array for Alternatives 1A and 1B for construction cost only. Table 3-6 has been updated to the MCACES level costs for Alt 1A and 1B to include construction and non-construction costs, and amortized accordingly at the FY17 discount rate of 2.875% for computation of average annual cost. The NER plan and TSP remain the same for recommendation of Alternative 1B.

36. In the Incremental Cost Analysis table (Table 3-6), the estimated cost of Alternative 1B (\$13,500,000) does not appear to match the total project cost in the Cost Appendix (\$11,992,000). This discrepancy should be corrected or explained.

RESPONSE: Concur. Once the NER Plan (TSP), Alternative 1B was identified it was further refined for the MCACES cost estimate (for reduction in volume of material needed for mangrove and seagrass habitat). However, to keep the costs comparable the initial MCACES estimates were compared for the construction and non-construction cost.

Cost Engineering (contd.)

37. Executive Summary "Cost Estimate and Implementation" Section: The cost has not been certified. It will be certified after ATR.

RESPONSE: Concur. Section has been updated to say "refined costs" rather than certified costs.

38. Table ES-3: This is not the updated version. Updated version will have the planning level estimate of 28OCT2016 and the Refined Cost Total is \$10,398,000 (construction only). Updated document will be sent.

RESPONSE: Concur. Updated table with most current cost estimates have been added to the report.

39. Table 4-1: The values used in this table should be the "Fully Funded Costs" and not the "Project First Costs"

RESPONSE: Concur. Table has been updated to reflect the fully funded costs with updated values. Table 4-2 has also been updated with current information.

40. Section 5.1 (mangrove planting): The TCPS does not have any costs for buying mangrove plants because they are expected to be donated. Does this cost in the monitoring need to include in TCPS as part of the mangrove monitoring plan? If the answer is yes, do I have to add a cost for mangrove planting as part of the construction?

RESPONSE: Concur. Adaptive Management Plan has been updated (@ \$0 per mangrove planting). Any cost changes will be addressed in the Cost ATR which is currently underway.

41. Section 5.1 (oyster monitoring): This cost was not incorporated in the original document. This cost needs to be captured in the TCPS.

RESPONSE: Adaptive Management Plan has been updated and any cost changes will be addressed in the Cost ATR which is currently underway.

As noted above, all concerns resulting from the DQC of the project have been fully resolved.

Eric Summa
Chief, Planning Division (*home district*)
CESAJ-PD

Date _____

Lauren Borocharner
Chief, Engineering Division (*home district*)
CESAJ-EN

Date _____

Appropriate additional signatures on following pages.

Dennis Zeveney
Chief, Geotechnical Engineering
Branch
CESAJ-EN-G

Date _____

Jason Engle
Chief, Water Resources Engineering
Branch
CESAJ-EN-WC

Date _____

David Dudley
Chief, Design Engineering Branch
CESAJ-EN-D

Date _____

Kim Brooks-Hall
Chief, Engineering Technical
Services Branch
CESAJ-EN-T

Date _____

David A. Tipple
Chief, Plan Formulation Branch
CESAJ-PD

Date _____

Mike Renacker
Chief, Watershed Resources Branch
CESAJ-PM-W

Date _____

Dan Vogler
CAP Planning Lead
CESAJ-PD-PW

Date _____

Melissa Reynolds
CAP Engineering Lead
CESAJ-EN-WH

Date _____

Audrey Ormerod
Chief, Real Estate
CESAJ-RE

Date _____

COMPLETION OF DISTRICT QUALITY CONTROL

Final District Quality Control (DQC) of **Lake Worth Lagoon Final Integrated Feasibility Report and Environmental Assessment** has been completed per direction of EC 1165-2-209. All concerns resulting from the DQC review of the project have been mutually resolved and comments incorporated.

SIGNATURE

Dan Vogler
Study Manager (PTL)
PD-PW

Date _____

SIGNATURE

Jim Suggs
Project Manager (*home district*)
PM-WN

Date _____

SIGNATURE

Melissa Reynolds
Engineer Project Manager (*ETL*)
EN-WH

Date _____

SIGNATURE

Jim Suggs
CAP Program Manager
PM-WN

Date _____

CERTIFICATION OF DISTRICT QUALITY CONTROL

There were no critical comments resulting from the Final DQC.

SIGNATURE

Eric Summa
Chief, Planning Division (*home district*)
PD

Date _____

SIGNATURE

Laureen Borocharner
Chief, Engineering Division (*home district*)
EN

Date _____

Add appropriate additional signatures (Operations, Construction, principal for DQC, etc.).

SIGNATURE

Dennis Zeveney
Chief, Geotechnical Engineering
Branch
EN-G

Date _____

SIGNATURE

Jason Engle
Chief, Water Resources Engineering
Branch
EN-WC

Date _____

Claude Russell Weeks Acting EN-W Branch Chief on 30 Nov 2017.

Acting Chief for Design Branch on 12/1/17.

SIGNATURE

David Dudley
Chief, Design Engineering Branch
EN-D

Date _____

SIGNATURE

Kim Brooks-Hall
Chief, Engineering Technical
Services Branch
EN-T

Date _____

SIGNATURE

Mike Renacker
Chief, Watershed Resources Branch
PM-W

Date _____

SIGNATURE

Kevin Wittman
Chief, SAD Regional
Socioeconomics
PD-D

Date _____

SIGNATURE

Dave Tipple
Chief, Plan Formulation Branch
PD-P

Date _____

SIGNATURE

Gina Ralph
Chief, Environmental Branch
PD-E

Date _____

SIGNATURE

Tori White
Chief, Real Estate Division (Acting)
RE

Date _____

SIGNATURE

Dan Vogler
CAP Planning Lead
PD-PW

Date _____

SIGNATURE

Melissa Reynolds
CAP Engineering Lead
EN-WH

Date _____

Agency Technical Review Certification

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017



**US Army Corps
of Engineers**®
Jacksonville District

Agency Technical Review Review Report

March 14, 2017

Lake Worth Lagoon, CAP Section 1135 - Palm Beach, Florida

Prepared By:

Coraggio Maglio, P.E., ATR Team Lead



**US Army Corps
of Engineers®**

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COMPLETION OF AGENCY TECHNICAL REVIEW

**LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP)
SECTION 1135, PROJECT FEASIBILITY
REPORT AND ENVIRONMENTAL ASSESSMENT
Decision Document and Related Appendices
14 March 2017**

Agency Technical Review (ATR) has been completed for the Lake Worth Lagoon, Continuing Authorities Program (CAP) Section 1135 Project decision document and related appendices. This ATR were performed in compliance with the requirements of EC 1165-2-214.

A panel of six reviewers was established by the Jacksonville District. The review commenced on 13 January 2016 and was completed on 14 March 2016. During the ATR, compliance with established policy, principles, and procedures was verified. This included review of assumptions, methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers policy.

Twenty nine (29) comments resulted from the general ATR of the draft documents, all of which were closed without controversy. The Cost Engineering MCX has signed off on cost calculations and coordination with them will continue through the study process.

Agreed upon analysis revisions and report updates as documented in Dr. Checks have been verified.

ATR Team Lead, CEMVN-EC-HB

Project Manager, CESAJ-PM-WN

Study Manager, CESAJ-PD-PW

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CERTIFICATION OF AGENCY TECHNICAL REVIEW

We certify that the ATR of the Section 1135 Decision Document and Related Appendices has been performed as required by EC 1165-2-214. All concerns resulting from ATR of the LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 1135, PROJECT FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT report have been fully resolved.

Laureen Borocharner, P.E.
Chief, Engineering Division,
CESAJ-EN

_____ 15 March 2017

Date

Eric Summa
Chief Planning
CESAJ-PD

Date

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AGENCY TECHNICAL REVIEW REPORT

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Agency Technical Review Report

1. SUBJECT

Review Report for the [Project Name] Project: Draft Integrated Feasibility Report and Environmental Assessment, Jacksonville District

2. SCOPE AND PURPOSE OF REVIEW

The purpose of this review report is to document the Agency Technical Review (ATR) of the Integrated Feasibility Report and Environmental Assessment for Review Report for the Lake Worth Lagoon, Continuing Authorities Program (CAP) Section 1135 Project for compliance and consistency with USAGE policies and technical guidance. The review was conducted at the request of the United States Army Corps of Engineers (USAGE) Jacksonville District (SAJ). The primary points of contact for SAJ was Al Walker, CESAJ-PD-PW, Dan Vogler, CESAJ-PD-PW, and Jim Suggs, CESAJ-PM-WN. The ATR team (ATRT) was led by Coraggio Maglio, CEMVN-EC-HB.

3. REFERENCES

This review report was prepared in reference to, in association to, and in accordance with the following:

- a. EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW.
- b. South Atlantic Division Regional Programmatic Review Plan for the Continuing Authorities Program (CAP)

4. PROJECT DESCRIPTION

The study area is located within LWL in Palm Beach County, Florida (Figure 1). The IWW runs the entire length of the lagoon, which is approximately 21 miles long and up to one mile wide and runs parallel to the coast line. Two barrier islands (Palm Beach and Singer Islands) separate LWL from the Atlantic Ocean. Eight causeways and bridges connect the mainland to the barrier islands. Lake Worth Inlet connects the northern part of the lagoon to the Atlantic Ocean, and is the entrance channel to the Port of Palm Beach. South Lake Worth Inlet (also known as Boynton Inlet) connects the southern part of the lagoon to the Atlantic Ocean, and is primarily used by recreational boaters to access the Atlantic Ocean.

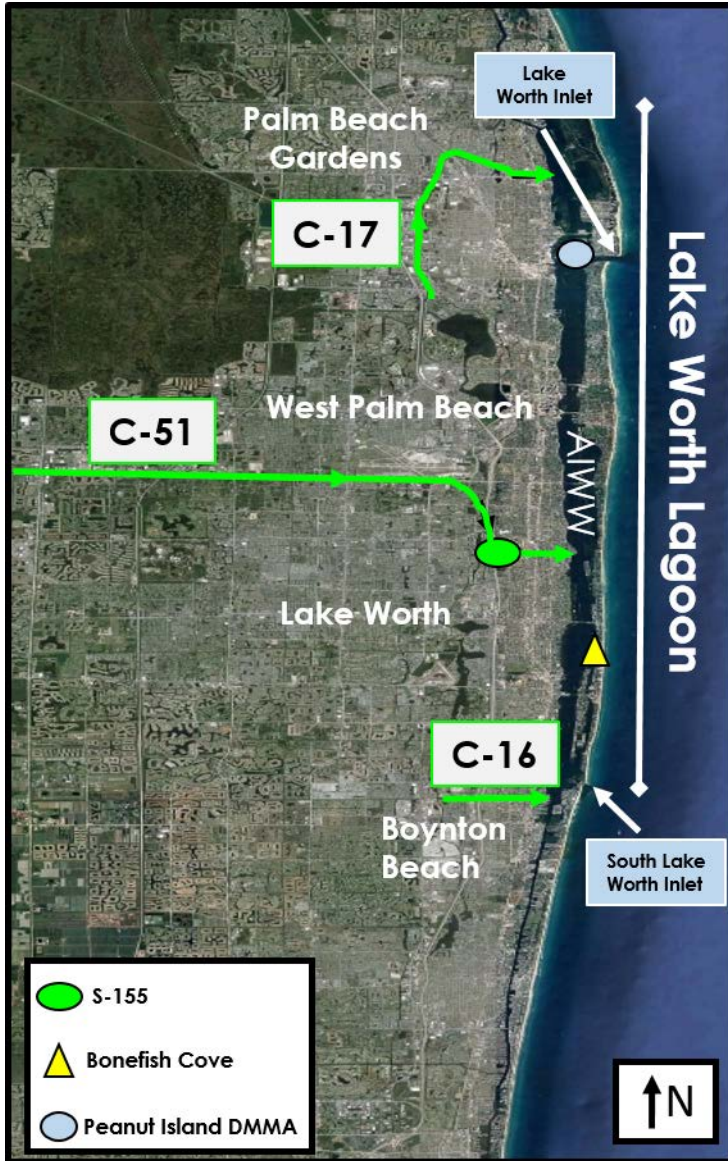


Figure 1: Map of project location and relevant features.

Lake Worth Lagoon, CAP Section 1135 Project
 INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

Lake Worth Lagoon (LWL) is currently experiencing habitat losses to its marine ecosystem, including losses of seagrasses, oysters, and other benthic marine features because of the direct freshwater discharges into LWL from the Central and Southern Florida (C&SF) regional water management system. Large freshwater discharges from Canals C-16, C-17, and C-51 (constructed in the 1980s by the U.S. Army Corps of Engineers (USACE) as part of the C&SF regional water management system) are causing sudden shifts in the water column, changing water quality conditions in the lagoon from brackish to low salinity condition. When these discharges occur, they can last for hours or even days, negatively impacting seagrasses, oysters, and other features of the LWL marine ecosystem. Additionally, federal dredging and filling activities associated with the Atlantic Intracoastal Waterway (IWW), and Palm Beach Harbor Navigation Project (PBHNP) further exacerbates additional losses in seagrass, mangrove, and oyster habitat. Delivery of fine-grained sediments and muck from these activities are gradually covering the natural sands and hardpan bottom of the lagoon floor, negatively affecting benthic habitat by partially or totally covering over oyster beds and other benthic features. Therefore, this study will address the need for a federal project to create sustainable habitats for marine ecosystem flora and fauna within LWL that will address the negative impacts to the lagoon’s marine ecosystem caused by the C&SF project and ongoing federal dredging activities occurring in the IWW. SAD approved the Federal Interest Determination (FID) for moving forward with the feasibility study on March 25, 2015.

5. REVIEW TEAM

The following ATR team members (Table 1) met the discipline requirements in the Review Plan and are on the respective approved Community of Practice reviewer lists or other appropriate lists. Refer to ENCLOSURE 3: ATR TEAM BIOGRAPHIES AND CONTACT INFORMATION for full biographies and contact information of ATRT.

Table 1: ATR Team Members

ATR Team Member	Title/Discipline	District
Coraggio Maglio	ATR Lead / Engineer	Galveston District(SWG)
Elden Gatwood	Plan Formulation	Wilmington District (SAW)
Jesse Helton	Environmental/NEPA	Charleston District (SAC)
Phil Ohnstad	Cost Engineer	Charleston District (SAD)
Jim Neubauer	Cost Engineer	Walla Walla District(NWW)
Kenneth Pablo	Real Estate	Galveston District (SWG)

6. CHARGE TO REVIEWERS

The review team was charged with the review of draft study documentation, both directly and indirectly related to their field of expertise. The team was encouraged to review all documents in the submission package and to verify overall consistency of report information among technical disciplines.

The purpose of this ATR was to ensure that technical analyses meet the requirements of technical regulations and to ensure policy compliance. The review should also ensure that appropriate problems and opportunities are addressed; confirm that a reasonable array of solutions are considered; confirm that an appropriate solution is recommended; assure that appropriate costs, schedules, and risks are presented; confirm the recommended solution warrants Federal participation; is in accord with policies; can be implemented in accordance with environmental laws and statutes; has a sponsor willing and able to fulfill the non-Federal responsibilities; and ensure that the decision document appropriately represents the views of USACE, the Army, and the President.

Accordingly, the review should:

- Identify, examine, and comment upon assumptions that underlie analyses (i.e. public safety, economic, engineering, environmental, and others)
- Evaluate the appropriateness of models selected for use in evaluations, the application of data within those models, and the interpretation of and conclusions drawn from model results.
- Bring important issues to the attention of decision makers.

Review Criteria for ATR:

- Products were reviewed for compliance with guidance, including Engineering Regulations, Engineering Circulars, Engineering Manuals, Engineering Technical Letters, Engineering Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE.
- Approved waivers should have been obtained from HQUSACE for any deviations from USACE guidance and documented in the review materials.

Key Review Considerations:

- The project meets the customer's scope, intent and quality objectives as defined in the PMP.
- Formulation and evaluation of alternatives are consistent with applicable regulations and guidance.
- Concepts and project costs are valid.
- The recommended alternative is feasible and will be safe, functional,

Lake Worth Lagoon, CAP Section 1135 Project
INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

constructible, environmentally sustainable, within the Federal interest, and economically justified according to policy.

- All relevant engineering and scientific disciplines have been effectively integrated.
- Appropriate computer models and methods of analysis were used and basic assumptions are valid and used for the intended purpose.
- The source, amount, and level of detail of the data used in the analysis are appropriate for the complexity of the project.
- The project complies with accepted practice within USACE.
- Content is sufficiently complete for the current phase of the project and provides an adequate basis for future development effort.
- Project documentation is appropriate and adequate for the project phase.

Additional considerations for Decision Documents:

- Recognizing that the quality of each decision document has a direct and immediate impact on the credibility of USACE and the Department of the Army, ATR on decision documents should address the basic communication aspects of the documents.
- The main decision document and appendices should form an integrated and consistent product.
- As an initial guide, the ATR team should consider the Project Study Issue Checklist in Exhibit H-2, Appendix H, ER 1105-2-100, which includes many of the more frequent and sensitive policy areas encountered in studies.
- Composition of Technical Comments (DrChecks). Comments should follow a four part structure, composed of the following:
 - A clear statement of the ATRT concern.
 - The basis for the concern (often a reference to guidance).
 - The significance of the concern.
 - A suggested action that would resolve the concern.
- General guidance or suggestions by the ATRT for future PDT consideration are acceptable as a technical comment. However, the commenter should indicate that "a PDT evaluation of 'noted' will be sufficient".

Coordination of Editorial Comments:

- Editorial comments about errors, such as spelling, composition, missing or erroneous table or graphic references, or about writing or documentation suggestions were noted by the ATRT and provided to the ATR lead for coordination with the PDT study manager or project manager.

Coordination of reviewer questions was directed through the review team lead and the project manager, who coordinated the questions with the appropriate project delivery team member(s).

7. SUMMARY

Overview Summary of the Review

Critical / High Significance

There was one (1) Critical / High Significance ATR comment. The following provides a brief summary of this comment

1. Cost Engineering (Comment 6804374)
 - a. Problem - The reviewer identified the labor rates in MII appear to meet or exceed the Davis Bacon wage rates and are not broken into taxable or non-taxable fringes. Concern is whether this is an appropriate method for your locale as compared to the Davis-Bacon wage determination. If the area is a right-to-work state, labor rates likely run higher than Davis-Bacon. If this is a strong labor union area, Davis-Bacon likely runs higher.
 - b. Resolution – The PDT added appropriate note in MII to the justify use of wage rates that exceed Davis Bacon rates of 2017 revision.

All critical / high significant comments were resolved and closed. There were no unresolved comments from previous reviews that were deferred to the ATR.

Unresolved.

All ATR comments have been resolved.

Summary of Cost Engineering

Cost certification was processed by Jim Neubauer with the Cost Engineering MCX.

8. PROJNET™DRCHECKS REPORT

Projnet™ DrChecks report of all comments is attached as **ENCLOSURE 1: PROJNET™ DRCHECKS REPORT OF ALL COMMENTS.**

9. ATR COMPLETION STATEMENT

ENCLOSURE 4: COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW contains the completion statement of a draft Agency Technical Review for this study.

ENCLOSURE 1: PROJNET™ DRCHECKS REPORT OF ALL
COMMENTS

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Comment Report: All Comments

Project: Planning ATR's

Review: Lake Worth Lagoon CAP ATR1

Displaying 29 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6804368	Cost Engineering	n/a	n/a	
n/a Comment Classification: Unclassified\\For				

Official Use Only (U\\FOUO)

(Document Reference: [Appendix C_Real Estate Plan](#))

CONCERN: Appendix C of the main report has the administrative costs split between the federal and non-federal sponsor and the TPCS splits these cost 75%/25%.

SIGNIFICANCE: Low.

RESOLUTION: Verify the non-federal project sponsor administrative costs split and update the report or TPCS.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

Revised Jan 20 2017.

1-1 Evaluation Concurred

The correct split for the federal and non-federal funds starting at the Design and Implementation is 75% (federal) and 25% (Non-federal). The Appendix C is the Real Estate Report only. The main report confirm the split of 75%/25% in the following pages ES-14, 4-7 and 6-1. In addition I included copy of the Federal Interest Determination Memorandum dated 22DEC2014 for the project. The current TPCS has the full amount of Real Estate (Federal and Non-federal). I will bring this concern to the Real Estate to confirm if they have different split as the feasibility report that is 50%/50%.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

No change to cost share % in TPCS or report. 75%/25% accurate so comment closed.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804371	Cost Engineering	n/a	n/a	
n/a Comment Classification: Unclassified\\For				

Official Use Only (U\FOUO)

(Document Reference: MII Estimate)

CONCERN: The MII estimate title is "Lake Worth Lagoon Alternative Comparison" and the estimate is for the Preferred Alternative 1B.

SIGNIFICANCE: Low.

RESOLUTION: Update title in MII.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

Action completed. The main title for the MII file have been updated to " Lake Worth Lagoon – Preferred Alternative"

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Title updated.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804374 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

(Document Reference: MII Estimate Labor Rates)

CONCERN: The Labor rates indicate Labor_Florida_2015 and All labor rates now meet the new 2015 Federal Minimum Wage (\$10.10/hour). The rates in MII appear to meet or exceed the davis bacon wage rates but are not broken into taxable or non-taxable fringes. Concern is whether this is an appropriate method for your locale as compared to the Davis-Bacon wage determination. If the area is a right-to-work state, labor rates likely run higher than Davis-Bacon. If this is a strong labor union area, Davis-Bacon likely runs higher.

SIGNIFICANCE: HIGH since labor rates are a main cost factor in the estimate.

RESOLUTION: Defend application of the applied labor rates. If local labor rates are higher than Davis-Bacon, use them. If Davis-Bacon is higher than standard construction labor, then use Davis-Bacon.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

Action completed. Each labor rates have been revised. To be conservative the high rates have been selected. Document used are Davis Bacon Wage Rates, and Florida Wages 2015.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Open Comment

Wage Rates used meet or exceed the 2017 Davis Bacon rates. Update comment in MII project properties to avoid confusion in the future.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017

1-3 Backcheck Recommendation Close Comment

Note added in MII that labor rates meet or exceed 2017 Davis Bacon rates.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Feb 02 2017

2-0 Evaluation Concurred

Added the following note to the MII under the Labor tab.

"The labors rates used for the estimate exceed the Davis Bacon rates of 2017 revision. The rates were obtained from the United States Department of Labor "May 2015 State Occupational Employment and Wages Estimates Florida". https://www.bls.gov/oes/current/oes_fl.htm"

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Feb 01 2017

Backcheck not conducted

Current Comment Status: **Comment Closed**

6804375 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

(**Document Reference: MII Estimate Mob/Demob Costs**)

CONCERN: There are mob/demob costs from CEDEP and some ground transportation costs but there is no mob/demob costs for the prime and subcontractor contractor equipment and jobsite setup.

SIGNIFICANCE: LOW.

RESOLUTION: Check mob and demob costs for prime contractor and subcontractors.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The Mob/Demob for DEDEP was revised. In addition I updated a MOB/Demob for the heavy equipment that include ground and water transportation. The JOOH have been modified from running to calculated for a more accrue cost. Both Mob/Demob have HOOH, Profit, and Bond. Action completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804401 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: CEDEP Fuel**)

CONCERN: The CEDEP fuel price is \$1.86/Gallon and does not match the fuel pricing in the backup data.

SIGNIFICANCE: Moderate.

RESOLUTION: Update fuel pricing to 5 year average for Diesel.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

Fuel price have been updated on CEDEP and the MII along with the cost of money. The backup data have been added to the project file. Action Completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804405 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: MII Diesel**)

CONCERN: The MII fuel price is the same for both on and off-road fuel.

SIGNIFICANCE: Moderate.

RESOLUTION: Update fuel pricing for on-road diesel.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

Fuel price have been updated on CEDEP and the MII along with the cost of money. The backup data have been added to the project file. Action Completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017

2-0 Evaluation Concurred

Fuel price have been updated on CEDEP and the MII along with the cost of money. The backup data have been added to the project file. Action Completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

Backcheck not conducted

Current Comment Status: **Comment Closed**

6804407 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: MII Narrative**)

CONCERN: The narrative indicates the quantities were provided by James Lagrone and should reference an office symbol.

SIGNIFICANCE: LOW.

RESOLUTION: Update narrative.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

James Lagrone name have been replace by his office symbol SAJ-EN-DW. Action completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804408 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: MII Estimate, RIPRAP Folder, Item Water transportation – Barge**)

CONCERN: The water transportation by barge has a UOM of 36 hours with a crew output of 4 which calculates to 9 hours. The total time required for this task is 36 hour.

SIGNIFICANCE: LOW.

RESOLUTION: Update productivity rate in MII.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

Revised Jan 20 2017.

1-1 Evaluation Concurred

Productivity rate have been updated on the MII. Action completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804412 Cost Engineering n/a n/a n/aComment
Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: CEDEP Crew Overtime**)

CONCERN: The Embankment creation crew is based on 8 hours a day, 7 days per week in CEDEP utilizing a 14.29% OT rate. The MII estimate note indicates the calculation is based on 8 hours per day, 6 days per week. The overtime rate for a single shift, 8 hours per day, 7 days per week is 21.43%. The concern is the excavation items and offloading the sand material from the scow assume no overtime and the transportation and pump out placement have overtime.

SIGNIFICANCE: Moderate.

RESOLUTION: Verify if overtime is required for the embankment transportation and pump out placement. If overtime is required, change the overtime rate in CEDEP.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

This estimate is based on 8 hour and 5 days per week. The CEDEP program have been adjusted to represent only 8 hrs and 5 days per week. In addition the OT rate have been removed. The schedule have been re-evaluate to ensure it represent the appropriate working hours and days.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

OT rate removed from CEDEP.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804414 Cost Engineering n/a n/a n/a
Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
(**Document Reference: Project Schedule**)

CONCERN: The schedule does not have the Oyster Monitoring.

SIGNIFICANCE: Low as this was included in the TPCS midpoint escalation calculations.

RESOLUTION: Update the construction schedule with the Oyster Monitoring.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The Oyster Monitoring have been added to the other two monitoring plan (Mangrove and seagrass) in the schedule and midpoint escalation do not change. Action completed.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017

Current Comment Status: **Comment Closed**

6804415 Cost Engineering	n/a	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
([Document Reference: Project Schedule](#))

CONCERN: There is an item in the schedule for "Monitoring" that begins in 2019 and additional item for Adaptive Management items that being in 2021.

SIGNIFICANCE: Low.

RESOLUTION: Clarify if these are the same items and update as necessary.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The monitoring that begin in 2019 is a turbidity monitoring during the construction. I added additional description to the task to avoid future confusion. Action complete.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804417 Cost Engineering	n/a	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**
([Document Reference: Project Schedule](#))

CONCERN: The construction schedule shows the start of loading the barge for 2/7 and the MII construction narrative indicates the best time to build is Nov 15-March 31 to avoid the Manatee season. The schedule indicates construction outside the construction window and could cause cost and schedule impacts.

SIGNIFICANCE: Low.

RESOLUTION: Either update the schedule or explore the manatee impacts as part of the risk analysis.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The statement "Best time to construct is from 15NOV to March 31" is a misinterpretation from my part. Please refer to "EN Attachment A". 15NOV to 31MAR is the manatee season but Florida Department of Environmental Protection allow to work in the area during the season. The Risk register have been update to present this information. The schedule will not need to be adjusted at this time. [A-16] Florida Department of Environmental Protection, "Environmental Resource Permit No. 50-0294306-002, issued pursuant to Part IV of Chapter 373, Florida Statutes (F.S.), and Title 62, Florida Administrative Code (F.A.C.)," Modification of Environmental Resource Permit for the Florida Inland Navigation District, 2014.

Florida Inland Navigation District environmental resource permit modification that clarifies when dredging may be performed. This modification specifies that dredging activities shall be permitted 24 hours per day, except for the November 15 thru March 31 time frame to reduce the possibility of injuring or killing a manatee during construction.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804418 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

(**Document Reference: Risk Analysis**)

CONCERN: Referencing the Risk Matrix, there are evaluations listed as N/A for risk items within a features of work.

SIGNIFICANCE: MODERATE.

RESOLUTION: Update Risk Register for all features of work including: Mob/Demob, Bank Stabilization, Associated General Items, and Adaptive Management Plan.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

All the features of work have been expose. An appropriate discussion paragraph have been added to explain why they do not represent a concern. Risk register have been updated. Action complete.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Updated risk register reviewed.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804419 Cost Engineering	n/a	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

(**Document Reference: Risk Register Acquisition Strategy**)

CONCERN: Referencing the Risk Matrix tab the Acquisition Strategy risks are only explored for the 30 account and not for the construction items. If all work is planned as a single contract, then it seems all risks would be the same.

SIGNIFICANCE: MODERATE.

RESOLUTION: Recommend revisiting.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The acquisition strategy risk in the Risk register have been updated based on your recommendation. The contingency increase due to the update. Action complete.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Jan 30 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Jan 31 2017 Current

Comment Status: **Comment Closed**

6804421 Cost Engineering	n/a	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

(**Document Reference: TPCS PED Costs**)

CONCERN: PED costs are 10% of the construction costs that includes 4% for engineering and design.

SIGNIFICANCE: Low.

RESOLUTION: Verify that 4% for engineering and design is sufficient.

Submitted By: [Phil Ohnstad](#) (509-527-7587). Submitted On: Jan 20 2017

1-1 Evaluation Concurred

The Project Manager reviewed the WBS 30 (Planning, Engineering & Design) with the ETL and the

% have been decreased to 3%. In addition, the PM have reviewed the rest of the WBS 30 and the TPCS have been revised and updated along with the MII and Risk Register.

Submitted By: [Rafael Torres Pagan](#) (904-232-3608) Submitted On: Feb 02 2017
(Attachment: [RE Draft TPCS LWL decrease PED.pdf](#))

1-2 Backcheck Recommendation Close Comment

30 and 31 rates verified in MII, TPCS, and Risk Analysis. Comment closed.

Submitted By: [Phil Ohnstad](#) (509-527-7587) Submitted On: Feb 02 2017 Current
Comment Status: **Comment Closed**

6810481 Environmental Section 2-4 Page 2-27 n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

Section 2-4, Page 2-27. No analysis of climate change or impacts to climate change from construction of the proposed project is included in the document. Climate Change analysis is require according to CEQ's recent guidance Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emission and the Effects of Climate Change in NEPA Reviews (August 1, 2016). Add discussion on climate change and impacts to climate change from this project. A basic climate change analysis should fulfill this requirement.

Submitted By: [Jesse Helton](#) (843-329-8145). Submitted On: Jan 25 2017

1-1 Evaluation Concurred

Between the climate and sea level sections in chapter 2, the analysis of the current conditions is sufficiently documented. To incorporate ATR Bio Comment 1 I added the following section and associated language:

3.5.8.11 CLIMATE

The project will not change the project area's climate. Minimal amounts of greenhouse gases would be created during construction of the proposed project; however, the release of GHG emissions will cease with completion of construction. The creation of mangrove islands and oyster and sea grass habitat may aid in the natural carbon capture and/or carbon sequestration processes.

Submitted By: [Kelci Mynhier](#) ((904) 232-2050) Submitted On: Jan 27 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Jesse Helton](#) (843-329-8145) Submitted On: Feb 03 2017 Current

Comment Status: **Comment Closed**

6810483 Environmental Section 2-4-6-1 and
throughout

n/a n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

Section 2-4-6-1 and throughout. Information is needed for the overall clarity of the report regarding risk to the success of the project from low salinity levels in LWL. Clear statements clarifying how the low salinity (that is negatively impacting existing oysters and sea grass within LWL) will not cause negative impacts on the oysters and sea grass this project proposes to create/restore should be included more clearly and more often in the report. The negative impacts of low salinity and the inability of the Corps to address salinity issues is mentioned many times. I suggest stating how low salinity will (or will not) impact the success of the project every time the negative impacts are mentioned. Based on the report construction of other projects (not by the Corps) may help alleviate low salinity episodes in LWL in the future.

Submitted By: [Jesse Helton](#) (843-329-8145). Submitted On: Jan 25 2017 Evaluation **Concurred**
To incorporate ATR Bio Comment 2, I added the following language to the following sections:

- Exec Sum – Alt Plans... Intro
- 1.4 Study Purpose and Need
 - 2.4.1 Vegetation
 - 2.4.2.1 Oysters
 - 2.4.3.1 Johnson's Seagrass

A previously completed restoration project, Snook Islands, is located closer to the S-155 freshwater discharge than the project's proposed locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species.

4.3 Risk and Uncertainty
however, the Snook Islands restoration project is located closer to the S-155 freshwater discharges than the proposed Bonefish and El Cid locations. Despite its close proximity to S-155, the Snook Islands project has demonstrated success at creating suitable habitat for lagoon species which indicates that the influence of S-155 on the selected site will be minimal.

Submitted By: [Kelci Mynhier](#) ((904) 232-2050) Submitted On: Jan 27 2017

1-1 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Jesse Helton](#) (843-329-8145) Submitted On: Feb 03 2017 Current

Comment Status: **Comment Closed**

6810493 Environmental	Section 3-5-8-4 (and other ESA sections).	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

Section 3-5-8-4 (and other ESA sections). The Corps effect determinations for Endangered Species are not give in the report. In order to clarify our compliance efforts with the ESA state the Corps effect determinations for each endangered species found in the study area. These determinations are listed in the letters that were sent to USFWS and NMFS as part of this study.

Submitted By: [Jesse Helton](#) (843-329-8145). Submitted On: Jan 25 2017

1-1 Evaluation Concurred

To incorporate ATR Bio Comment 3 – I added the following language to sections Exec Sum (Coord w/agencies and the public), 3.5.8.4 Threatened and Endangered Species, and 5.6 (ESA of 1973):

USACE has concluded the project may affect, but is not likely to adversely affect (MANLAA) the species listed above and will not affected any designated critical habitat (DCH).

Submitted By: [Kelci Mynhier](#) ((904) 232-2050) Submitted On: Jan 27 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Jesse Helton](#) (843-329-8145) Submitted On: Feb 03 2017 Current

Comment Status: **Comment Closed**

6819973 Construction Management 1.p. 4-4 & Figure n/a

4-4 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Is there sufficient depth for barges to bring in riprap? Between the 2002 and 2015 surveys the adjacent depths have decreased by about one foot. On the east side (Figure 4-4b) the adjacent topography appears to have shoaled to the planned -5.5ft toe of slope just 10-20 feet from the toe. If the shoaling continues, at time of construction the depth will be even shallower. Please specify the plan for riprap placement in the areas that are too shallow for barges.

Submitted By: [Coraggio Maglio](#) (6016344150). Submitted On: Feb 01 2017

1-1 Evaluation Concurred

There is sufficient depth for the barges to bring the rock to the project site. The county placed similar rip rock for the their grassy flats project (Figures 4-2 and 4-4 of the EN Appendix) which is shallower than the Bonefish project area. The county informed the contractors that they would need to light load their barges while operating in this area. At the bonefish area, shoaling is not likely to occur because we compared the 2015 to the countywide survey done in 2003 and noticed very little shoaling with the project placement area

Submitted By: [James LaGrone](#) ((904) 232-2437) Submitted On: Feb 14 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Coraggio Maglio](#) (6016344150) Submitted On: Feb 22 2017 Current

Comment Status: **Comment Closed**

Engineering 6819978 Management	n/a	n/a	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

Riprap sizing calculations - The only reference that I see that backs up stone size selection is that the same size will be used as has been used previously in this area. You may want to specify what has been used successfully in the area in the past and/or provide calculation for stone size

Submitted By: [Coraggio Maglio](#) (6016344150). Submitted On: Feb 01 2017

1-1 Evaluation Concurred

The stone size selected in the cost appendix was provided by the county for their Snook Island and Grassy Flats projects. The actual sizing of stone will be done in the Design and Implementation (D&I) phase. This is noted in the EN appendix heading titled "Protective Riprap" (Page 69).

Submitted By: [James LaGrone](#) ((904) 232-2437) Submitted On: Feb 14 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Coraggio Maglio](#) (6016344150) Submitted On: Feb 22 2017 Current

Comment Status: **Comment Closed**

6819995 Engineering Management	n/a	p.ES-15 Residual Risk	n/a
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Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

How do we know that the islands' habitat will survive continuing muddy freshwater discharges? and "can withstand current conditions associated with the freshwater discharges". How have the other similar already completed sites performed? Annual monitoring reports from other similar sites might want to be included as appendices, as available.

Submitted By: [Coraggio Maglio](#) (6016344150). Submitted On: Feb 01 2017

1-1 Evaluation Concurred

We know the project will be successful due the County's Snook Island project. The snook Island project is closer to the C51 releases than the current proposed Bonefish area. This project and others similar in scope are discussed in the EN appendix under the heading titled "Island Creation" and in EN Attachment C.

Submitted By: [James LaGrone](#) ((904) 232-2437) Submitted On: Feb 17 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Coraggio Maglio](#) (6016344150) Submitted On: Feb 22 2017 Current
Comment Status: **Comment Closed**

6821563 Real Estate
REP

n/a

Section 5 and 11 of

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

n/a

Suggest including the definition of Navigation Servitude below as stated in ER 405-1-12-12-7.

Definition. The navigation servitude is the dominant right of the Government under the Commerce Clause of the U.S. Constitution (U.S. CONST. art.I, §8,cl.3) to use, control and regulate the navigable waters of the United States and the submerged lands thereunder for various commerce-related purposes including

navigation and flood control. In tidal areas, the servitude extends to all lands below the mean high water mark. In non-tidal areas, the servitude extends to all lands within the

bed and banks of a navigable stream that lie below the ordinary high water mark.

Submitted By: [Kenneth Pablo](#) (409-766-3816). Submitted On: Feb 02 2017

1-1 Evaluation Concurred

Will review definition based on RE-A direction.

Submitted By: [Jerome Morgan](#) (904-232-1146) Submitted On: Feb 09 2017

1-2 Backcheck Recommendation Close Comment

No comment.

Submitted By: [Kenneth Pablo](#) (409-766-3816) Submitted On: Feb 09 2017

Current Comment Status: **Comment Closed**

6821567 Real Estate	n/a	Section 5
of REP	n/a Comment Classification:	

Unclassified\\For Official Use Only (U\\FOUO)

The REP must address the land requirements needed to support the habitat for mangroves, seagrass, and an oyster reef environment protected by riprap (Figure 2: Bonefish Habitat) at Lake Worth Lagoon in Palm Beach County. Is this area within navigation servitude? Is the servitude being relied upon for this access through a sufficient legal nexus to navigation? Who is the underlying fee owner?

Submitted By: [Kenneth Pablo](#) (409-766-3816). Submitted On: Feb 02 2017

1-1 Evaluation Concurred

The habitat creation is a result of material from Peanut Island DMMA which are lands provided from previous projects to create the habit. The lands requirement are addressed. The fee owner will be Palm Beach County after creation and will not disrupt the nexus to navigate the lagoon.

Submitted By: [Jerome Morgan](#) (904-232-1146) Submitted On: Feb 09 2017

1-2 Backcheck Recommendation Close Comment

No comment.

Submitted By: [Kenneth Pablo](#) (409-766-3816) Submitted On: Feb 09 2017

Current Comment Status: **Comment Closed**

6821569 Real Estate n/a Section 6 of REP n/a

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

Comment: Add the estate numbers you are using. e.g. Standard estate No. 3.

Submitted By: [Kenneth Pablo](#) (409-766-3816). Submitted On: Feb 02 2017

1-1 Evaluation Concurred

Estate number will be added.

Submitted By: [Jerome Morgan](#) (904-232-1146) Submitted On: Feb 09 2017

1-2 Backcheck Recommendation Close Comment

no comment.

Submitted By: [Kenneth Pablo](#) (409-766-3816) Submitted On: Feb 09 2017 Current

Comment Status: **Comment Closed**

6821570 Real Estate n/a Section 25 of REP

Comment Classification: **Unclassified\For Official Use Only (U\FOUO)**

n/a

Is the cost to acquire the Borrow, Road and TWA easement included in the Fed/Non-Fed cost?

Submitted By: [Kenneth Pablo](#) (409-766-3816). Submitted On: Feb 02 2017

1-1 Evaluation Concurred

The lands were provided from previous projects by the sponsor so there will not be a crediting requirement for this project.

Submitted By: [Jerome Morgan](#) (904-232-1146) Submitted On: Feb 09 2017

1-2 Backcheck Recommendation Close Comment

no comment.

Submitted By: [Kenneth Pablo](#) (409-766-3816) Submitted On: Feb 09 2017

Current Comment Status: **Comment Closed**

6839805 Planning - Plan

Sec 3 - 4

n/a

n/a

Formulation

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Why did costs rise so dramatically with large differential between 1A and 1B, particularly given similar measures at both sites? Concern: 1A may still be a component of a Best-Buy Plan. Or is this ultimately related to staying below 1135 CAP cost threshold?

Submitted By: [Elden Gatwood](#) (562-833-8592). Submitted On: Feb 14 2017

1-1 Evaluation Check and Resolve

The cost increase from Alternative 1A and 1B is based on the amount of cubic yards of fill needed to build islands over a larger area (the muck hole at El Cid (Alternative 1A) is ~26 acres; the muck hole at Bonefish (Alternative 1B) is ~50 acres). Additionally, Alternative 1B is located farther from the DMMA, and thus transportation costs to move the fill material are higher. This text can be found in Sections 3.5.2 and 3.5.3. The difference in cost/size between alternatives is a scaling issue. Alternative 1B provides the Best Buy - NER alternative.

Submitted By: [Dan Vogler](#) (904-232-3634) Submitted On: Feb 17 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Elden Gatwood](#) (562-833-8592) Submitted On: Feb 17 2017

Current Comment Status: **Comment Closed**

6839808 Planning - Plan

Sec 3 - 4

n/a

n/a

Formulation

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Proposed project does not address freshwater impacts to proposed habitat. It is expected that L-8 and C-51 will ameliorate impacts from those sources?

Submitted By: [Elden Gatwood](#) (562-833-8592). Submitted On: Feb 14 2017

1-1 Evaluation Check and Resolve

Yes. Freshwater flows will not be affected by this project. This project will provide beneficial habitat to several species despite impacts from freshwater flows, as evidenced

by the success of the Snook Islands project- which is located closer to the freshwater outlets than the proposed project site.

Submitted By: [Dan Vogler](#) (904-232-3634) Submitted On: Feb 17 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Elden Gatwood](#) (562-833-8592) Submitted On: Feb 17 2017

Current Comment Status: **Comment Closed**

6839815	Planning - Plan			
	Formulation	n/a	p.2-27	n/a
	Comment Classification: Unclassified\\For Official Use Only (U\\FOUO)			

If more canals are likely in FWOP condition, how will those increased freshwater inflows be accommodated in order not to affect proposed habitat?

Submitted By: [Elden Gatwood](#) (562-833-8592). Submitted On: Feb 14 2017

1-1 Evaluation Check and Resolve

This project will not affect the amount or timing of freshwater inflow to Lake Worth Lagoon. The majority of freshwater flows will continue from C-51, C-16, and C-17. Due to the level of development in the region, additional canal construction that would introduce new freshwater flows is not anticipated.

Submitted By: [Dan Vogler](#) (904-232-3634) Submitted On: Feb 17 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Elden Gatwood](#) (562-833-8592) Submitted On: Feb 17 2017

Current Comment Status: **Comment Closed**

6839819	Planning - Plan			
	Formulation	Sec. 3.5.9.1.3	n/a	n/a
	Comment Classification: Unclassified\\For Official Use Only (U\\FOUO)			

This section would benefit from the CE/ICA graphic illustrating Best-Buy outcomes.

Submitted By: [Elden Gatwood](#) (562-833-8592). Submitted On: Feb 14 2017

1-1 Evaluation Check and Resolve

Table 3.5 identifies the two cost effective plans. Table 3-6 identifies the best-buy plan (1B), based on the incremental cost analysis. Given the way the data is presented, it does not appear necessary to have a graphic comparing the two best buy plans presented in Table 3-6.

Submitted By: [Dan Vogler](#) (904-232-3634) Submitted On: Feb 17 2017

1-2 Backcheck Recommendation Close Comment

Closed without comment.

Submitted By: [Elden Gatwood](#) (562-833-8592) Submitted On: Feb 17 2017

Current Comment Status: **Comment Closed**

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ENCLOSURE 2: CRITICAL / HIGH SIGNIFICANCE COMMENTS DEFERRED TRACKING LIST

CRITICAL / HIGH SIGNIFICANCE COMMENTS DEFERRED TRACKING LIST

This table tracks and documents previously agreed upon ATR Critical / High Significance Closed Comments that require changes to the review document, but were deferred to this ATR review. These deferred comments are tracked by the ATR Lead and added as new comments for back check and validation of the comment close out during this ATR.

DrChecks Cmt #	Original DrChecks Cmt # / Review	Change/Issue to Be Tracked	Resolution / Date
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THERE WERE NO DEFERRED COMMENTS

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ENCLOSURE 3: ATR TEAM BIOGRAPHIES AND CONTACT INFORMATION

ATR Lead - Coraggio Maglio SWG-EC-HB - 601-634-4150,
Coraggio.k.maglio@usace.army.mil

Mr. Coraggio Maglio is a Professional Engineer with 12 years of specialized experience in coastal processes, and freshwater and estuarine systems. He attained a Masters in Ocean Engineering from the Florida Institute of Technology as well as a Bachelors of Natural Sciences from New College of Florida. Born and raised in Florida, his hobbies include surfing, gardening, and native landscaping. He is a strong, sensible environmentalist and lover of nature, especially coastal areas.

In his current position at the U.S. Army Corps of Engineers, Galveston District, as the Hydraulics and Hydrology Branch Chief, he incorporates his knowledge and love of sensible sustainability into every project he manages, researches, or on which he advises. The diversity of his work experience ranges from storm damage reduction projects, beach and ecosystem restoration, navigation dredging, and flood protection. His diverse and accomplished knowledge of physical and biological science, field data collection, engineering and permitting processes, project management, and construction techniques allows for improved practical inclusive resolutions.

He is recognized for his “out of the box” thinking and innovative approach to project solutions. Given his innovations as a design engineer and researcher, combined with talented listening and communication skills, difficult and complex issues are efficiently resolved. His passion inspires those around him and promotes his teams to exceed expectations. As a result, he is viewed as solution oriented and capable of “fixing” sensitive and intricate problems.

Plan Formulation – Elden Gatwood, CESAW-ECP-P - 562-833-8592,
Elden.j.gatwood@usace.army.mil

Elden Gatwood has over 30 years of experience as a Hydraulic Engineer & Watershed Plan Formulator supporting USACE. He has experience as both a Hydraulic Engineer, Planning Lead, Project Manager & Senior Planning & Policy Review on multiple Civil Works projects. Civil Works experience has been primarily within H&H, sediment transport, coastal improvements, and flood risk management, ecosystem and navigation studies. Elden served as lead planner and project manager for Mississippi Coastal Improvements Project. Experience also includes serving as Lead for Plan Formulation, Senior Policy Expert - Planning and Policy Community of Practice, South Atlantic Division as well as Chief, Planning and Environmental Branch, Wilmington District, USACE, 2010-present

Environmental Resources – Jesse Helton, CESAC-PM-PL, 843-329-8145
Jesse.s.helton@usace.army.mil

Jesse S. Helton joined the U.S. Army Corps of Engineers Charleston District (CESAC) as a Biologist in 2014. Previous positions include Biologist for the U.S. Army Corps of Engineers Louisville District (CELRL) from 2009 to 2014. Mr. Helton earned a Bachelor of Arts degree in Biology from Carson-Newman University in 2006 and a Master's of Science degree in Biology from Tennessee Technological University (TTU) in 2009. While at TTU he researched population trends in freshwater mussel assemblages in a CELRL regulated river. His thesis was an evaluation of the effectiveness of non-parametric species richness estimators and their potential to identify areas where rare species may be present but remain undetected due to their low densities. Mr. Helton also operated an aquatic culture facility for endangered mussel species. Upon completion of his education, Mr. Helton joined CELRL. He was the subject matter expert on aquatic nuisance species, team lead for NEPA actions at 20 CELRL lake projects, lead author for NEPA documentation on several civil works projects, and was deployed during the emergency response for Hurricane Sandy. During his time with CESAC, Mr. Helton has served as the lead biologist on a variety of projects, including water infrastructure projects, Section 206 studies and various military contracts. He also has worked in a supporting role on the Post 45 Deep Draft Navigation Study. In addition to his role as a biologist Mr. Helton has worked as a plan formulator on the Polk Swamp Section 206 Project. Mr. Helton completed the USACE Level II Leadership Development Program while at CESAC.

Real Estate – Kenneth Pablo, CESWG-RE - 409-766-3816,
Kenneth.pablo@usace.army.mil

Mr. Kenny Pablo is the Lead Realty Specialist for Planning Studies for the Galveston District. Mr. Pablo has over 6 years of experience in this role and is currently the Real Estate PDT representative on two "Mega Studies." Additionally, Mr. Pablo has worked on a host of other studies across the Civil Works spectrum including deep draft and shallow draft navigational studies and dredged material management plans (DMMP), flood risk management projects and ecosystem restoration projects. Mr. Pablo has participated in three Civil Works Review Board Projects. Mr. Pablo has also performed acquisition work for others to include the Customs and Border Patrol on the Freer Border Patrol Station, the Falfurrias Checkpoint Station and the Rio Grande City Border Patrol Station; as well as for US Department of Transportation, Maritime Administration's Layberth Facility Project in Beaumont, Texas.

A small sampling of Mr. Pablo's Civil Works projects include the Sabine Pass to Galveston Bay, Texas Coastal Storm Risk Management and Ecosystem Restoration Project; Coastal Texas Protection and Restoration Project; the Houston Ship Channel 45-Foot Expansion Channel Improvement Project; the Greens Bayou Houston, Texas Flood Damage Reduction Project; the Cedar Bayou DMMP; the Chocolate Bayou DMMP; the Houston Ship Channel DMMP; the Corpus Christi Ship Channel Project; the Texas City Channel Improvement Project; and, the Addicks and Barker Dam Safety Project.

Cost Engineering - Jim Neubauer, CENWW, 509-527-7332
James.G.Neubauer@usace.army.mil

James Neubauer, PE, CCE, PM serves as a national cost engineering consultant, having an accumulated 34 years of engineering experience: 14 years construction, 5 years project management and 15 years cost engineering. Since August 2007 Mr. Neubauer has served as the Cost Engineering MCX ATR Coordinator and a lead cost reviewer. Mr. Neubauer is also the lead instructor of the Cost ATR process, providing training to planners and estimators throughout the Corps. Since 1992, Mr. Neubauer has served as a senior lead cost engineer for Albuquerque District, Europe District and Walla Walla District. Mr. Neubauer was recognized as the USAGE Cost Engineer of the Year 2006-2007. He is especially skilled in estimates and reviews related to civil works earthwork and concrete structures, but has been involved in every aspect of civil works projects related to storm damage reduction, flood risk management, navigation, ecosystem restoration. Mr. Neubauer assisted the development of the current civil works cost Engineer Guidance documents ER 1110-1-1300, ER 1110-2-1302, ETL 1110-2-573, the current Cost and Schedule Risk Analysis Guidance, the Abbreviated Risk-Based Contingency model, and the Cost ATR Guidance for the US Army Corps of Engineers. Mr. Neubauer has led many cost ATRs, risk analyses and numerous teams in developing or reviewing multi-billion dollar estimates for the Corps and the Department of Energy.

Cost Engineering – Phillip C. Ohnstad, CENNW-EC-X – 509-527-7587,
Phillip.C.Ohnstad@usace.army.mil

Phil is a Certified Professional Constructor and Certified Cost Consultant currently working in the Walla Walla Cost Center of Expertise (DX) located in Walla Walla, WA. He has 9 years of cost engineer experience and an additional 17 years of civil and mechanical project management experience in the private industry. Phil has a Bachelor's degree in Construction Engineering Technology from Montana State University and a Master of Construction Engineering Management from Montana State University. He has been involved in a multitude of navigation, dam and levee projects, environmental restoration projects and technical reviews.

ENCLOSURE 4: COMPLETION STATEMENT OF AGENCY
TECHNICAL REVIEW (COPY)

COMPLETION OF AGENCY TECHNICAL REVIEW

**LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP)
SECTION 1135, PROJECT FEASIBILITY
REPORT AND ENVIRONMENTAL ASSESSMENT
Decision Document and Related Appendices
14 March 2017**

Agency Technical Review (ATR) has been completed for the Lake Worth Lagoon, Continuing Authorities Program (CAP) Section 1135 Project decision document and related appendices. This ATR were performed in compliance with the requirements of EC 1165-2-214.

A panel of six reviewers was established by the Jacksonville District. The review commenced on 13 January 2017 and was completed on 14 March 2017. During the ATR, compliance with established policy, principles, and procedures was verified. This included review of assumptions, methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers policy.

Twenty nine (29) comments resulted from the general ATR of the draft documents, all of which were closed without controversy. The Cost Engineering MCX has signed off on cost calculations and coordination with them will continue through the study process.

Agreed upon analysis revisions and report updates as documented in Dr. Checks have been verified.

ATR Team Lead, SWG-EC-HB

Project Manager, CESAJ-PM-WN

Study Manager, CESAJ-PD-PW

**ENCLSOURE 5: CERTIFICATION OF AGENCY TECHNICAL
REVIEW (COPY)**

CERTIFICATION OF AGENCY TECHNICAL REVIEW

We certify that the ATR of the Section 1135 Decision Document and Related Appendices has been performed as required by EC 1165-2-214. All concerns resulting from ATR of the LAKE WORTH LAGOON, CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 1135, PROJECT FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT report have been fully resolved.

Laureen Borocharner, P.E.
Chief, Engineering Division,
CESAJ-EN

Date

Eric Summa
Chief Planning
CESAJ

Date

Value Engineering Certification

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017



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REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207

CESAJ-PM-WN

20 December 2017

MEMORANDUM FOR RECORD

SUBJECT: Value Engineering Study Certification for Lake Worth Lagoon, Continuing Authorities Program Section 1135 Project, Integrated Feasibility Report and Environmental Assessment, P2#447752

I, James L. Suggs, certify that this decision document has completed the Value Engineering process as required by ER 11-1-321, Army Programs Value Engineering. A Value Management Plan has been completed for the project that recommends that value analysis be performed during the design phase of the project.

[Redacted Signature Box]

JAMES L. SUGGS
Project Manager
Jacksonville District

[Redacted Signature Box]

AUTUMN N. ZIEGLER, P.E.
Value Engineering Officer
Jacksonville District



Value Management Plan

(PMBP REF8023G)

Civil Works:
 Military:

Project/Procurement Amount Cost = \$9,000,000

Agency: USACE
 District: SAJ

P2#: 447752

Date: 3/21/2016

PN:

Filled Out By: Autumn Ziegler, PE, AVS

Project Title: Lake Worth Lagoon

Project Manager: Jim Suggs

Goal: (Statement of overall goal of VM/E effort)

The Value Management Plan (VMP) is being prepared in compliance with ER-11-1-321, Change 1 dated Jan 2011. The VMP will document compliance with Value Engineering regulations by determining the best strategy based on the complexity and cost of the project. The overall goal of the VM/E effort will be to document that a VE study is required based on the opportunity for the project to benefit from value analysis.

Objective: (Specific items of accomplishment that the VM/E effort will achieve as specific to the project)

A VE study is needed due to the opportunity for the project to benefit from a value analysis. The purpose of this Value Management Plan is to document concurrence with this selected VE strategy. Possible topics for the VE Team to consider during the workshop include refinements to the recommended plan from the feasibility phase, sequence of construction, construction techniques, lessons learned from previous projects, design parameters, and testing and acceptance criteria.

Execution - VE Strategy & Level of Effort: (Document Decisions from Sections I & II)

Selected VE Strategy: (Select Only One Strategy)

Design Agent VE Compliance

Date of Compliance: _____

No Further Action

Reason: _____

Low Opportunity - VMP Only

Low Opportunity - Bridge

Low Opportunity - Scan

Value Planning (Level 1)

Abbreviated Study (Level 2)

Standard Study (Level 3)

Problem Resolution (Level 4)

Programmatic (Level 5)

Enterprise (Level 6)

VE Activity Preliminary Schedule	
Overall VE Start (ML285, CW285, CW192)	TBD
VE Activity Start	TBD
VE Activity Finish	TBD
Overall VE Finish (ML290, CW290, CW195)	TBD

Level of Effort:

Single Effort

Multiple Efforts

VE Team:

Independent

Integrated

Blended

Value Engineering Budget:

Cost Category	Cost	Remarks
VEO Labor	\$15,000	VEO Labor for VMP Preparation and Coordination
Independent VE Team Member Labor		Labor for Non-CESAJ VE Team Members
In-House VE Team Labor	\$15,000	Labor for CESAJ In-House VE Team Members
A-E Services Contract		Budget is an estimate. Actual contract cost to be determined.
Contracting		Fee for CESAJ Contracting to Award and Close-out Task Order
VEO Travel		For projects requiring site visits
Total Budget	\$30,000	

Signature & Date of Project Manager (Required)

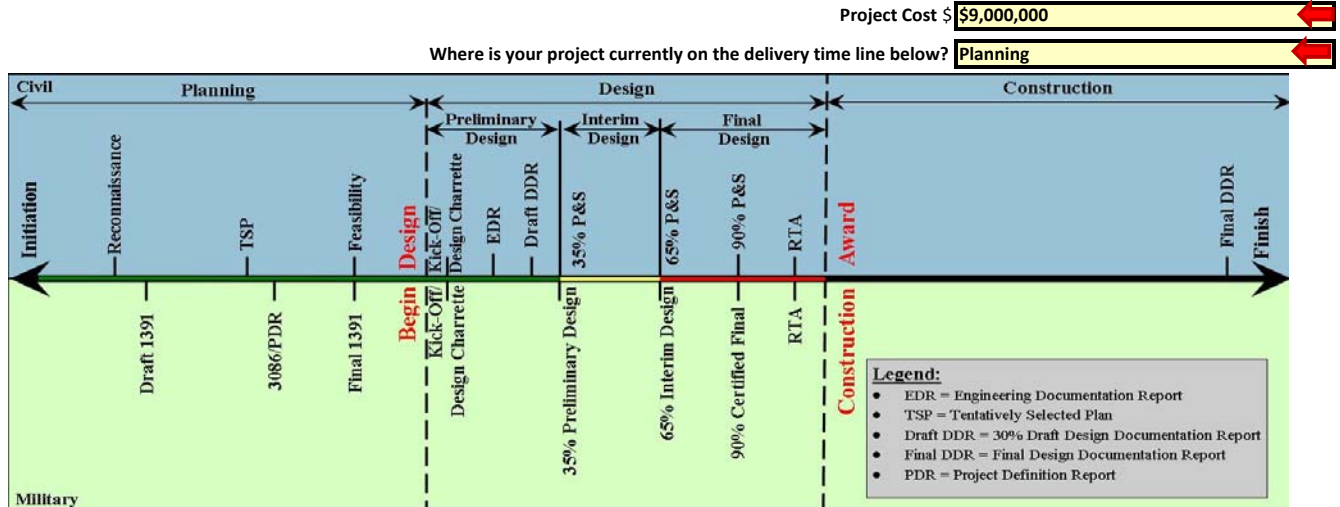
Signature & Date of VEO (Required)



Screening Tool

P2#: 447752	Date: 3/21/2016
PN:	Filled Out By: Autumn Ziegler, PE, AVS
Project Title: Lake Worth Lagoon	Project Manager: Jim Suggs

I. Initial Screening Process



- | | | |
|---|---|---|
| A) Is the Project/Procurement federally funded? | Yes <input checked="" type="checkbox"/> | No <input type="checkbox"/> If No, document as No Further Action. |
| B) Is the Corps the design agent? | Yes <input checked="" type="checkbox"/> | No <input type="checkbox"/> If No, document design agent compliance. |
| C) Has a programmatic study been previously executed within the last 3 years? Allowed before 35% Design only. (Determines if a Bridge Strategy is an option) | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> If Yes, can select Bridge Strategy as long as design is below 35%. |
| D) Could this be a part of a programmatic study? (Automatically determines Programmatic Strategy) | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> If Yes, select Programmatic Strategy. |
| E) Are there at least 5 similar studies within the last 3-5 years in the same region? Allowed before 35% Design only. Applicable to projects in the \$2-\$10M range with MSC approval; projects over \$10M require HQ Ch. OVE approval (Determines if Scan Strategy is an option) | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> If Yes, can select Scan Strategy as long as design is below 35%. If opportunity to change exists outside of past studies, do not select Yes. |
| F) Is the project/program/procurement over \$10M? | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> If Yes, proceed to Strategy Screening Process in Section II below. |
| G) Is there a program specific screening tool? | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> If Yes and not pre-flagged as low opportunity, proceed to program specific screening tool. |

II. VE Strategy Screening Process (work with PDT)

A) Project Specific

- | | | | |
|--------------------------------------|---|---|---------------------------------------|
| 1) Disciplines Involved | Couple (<2) <input type="checkbox"/> | Few (2-4) <input checked="" type="checkbox"/> | Several (>4) <input type="checkbox"/> |
| 2) Scope – Simple/Complex | Simple <input checked="" type="checkbox"/> | Moderate <input type="checkbox"/> | Complex <input type="checkbox"/> |
| 3) New/Renovate/Addition | New <input checked="" type="checkbox"/> | Addition <input type="checkbox"/> | Renovation <input type="checkbox"/> |
| 4) Unique or Standard Type Design | Unique <input checked="" type="checkbox"/> | Repetitive <input type="checkbox"/> | |
| 5) Constraints | Minimal <input checked="" type="checkbox"/> | Moderate <input type="checkbox"/> | Significant <input type="checkbox"/> |
| 6) Single Phase/Multi-Phase | Single <input checked="" type="checkbox"/> | Multiple <input type="checkbox"/> | |
| 7) Single Facility/Multiple Facility | Single <input checked="" type="checkbox"/> | Multiple <input type="checkbox"/> | |
| 8) Status of Design | Early <input checked="" type="checkbox"/> | 35% <input type="checkbox"/> | 65% or later <input type="checkbox"/> |

B) Stakeholders

- | | | | |
|-------------------------------------|--|---|----------------------------------|
| 1) Level of PDT Experience | Limited <input type="checkbox"/> | Substantial <input checked="" type="checkbox"/> | Unknown <input type="checkbox"/> |
| 2) Applicability of Team Experience | Applicable <input checked="" type="checkbox"/> | N/A <input type="checkbox"/> | Unknown <input type="checkbox"/> |
| 3) Design Provided by Others | Yes <input type="checkbox"/> | No <input checked="" type="checkbox"/> | |

C) Risk/Opportunity

- | | | | |
|---|---|--|--|
| 1) Confidence in Budget Estimate | Low <input type="checkbox"/> | Moderate <input type="checkbox"/> | High <input checked="" type="checkbox"/> |
| 2) Adequacy of Schedule – Design & Construction | Adequate <input type="checkbox"/> | Moderate <input checked="" type="checkbox"/> | Tight <input type="checkbox"/> |
| 3) Technical Risk – Design & Construction | Low <input checked="" type="checkbox"/> | Moderate <input type="checkbox"/> | High <input type="checkbox"/> |
| 4) Opportunity for Beneficial Change | Low <input checked="" type="checkbox"/> | Moderate <input type="checkbox"/> | High <input type="checkbox"/> |

Complexity Judgment - Assess complexity of overall circumstances (A-C) → Low Moderate High

See Page 3 for Complexity Narrative and Explanation of Selected VE Strategy.



Screening Tool - Narrative

P2#: 447752

Date: 3/21/2016

PN:

Filled Out By: Autumn Ziegler, PE, AVS

Project Title: Lake Worth Lagoon

Project Manager: Jim Suggs

Narrative: (Selected VE Strategy / Complexity)

Lake Worth Lagoon is located in Palm Beach County, Florida. It runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Palm Beach Island and Singer Island. It is approximately 20 miles long and up to one mile wide. The Lake Worth Inlet connects the northern part of the lagoon to the ocean and is the entrance channel to the Port of Palm Beach. South Lake Worth Inlet (also known as Boynton Inlet) connects the southern part of the lagoon to the ocean and is primarily used by recreational boaters. The Atlantic Intracoastal Waterway (IWW) runs the entire length of the lagoon. Eight causeways and bridges connect the mainland to the barrier islands.

Due to Federal dredging and filling activities associated with the IWW and Palm Beach Harbor Navigation Project (PBHNP), Lake Worth Lagoon has encountered severe losses in seagrass, mangrove, and oyster habitat. The loss of habitat has also been exacerbated, if not directly caused, by discharges from Canals C-16, C-17 and C-51 which were constructed by the U.S. Army Corps of Engineers in the 1980s as part of the Central and Southern Florida (C&SF) regional water management system and subsequently turned over to the South Florida Water Management District (SFWMD) for operation and maintenance.

The Recommended Plan consists of an approximate 50-acre eco-island chain at the Bonefish Cove dredge site in Lake Worth Lagoon. The eco-islands will consist of approximately 345,000 yards of material from the Peanut Island Dredge Disposal Management Area. Eight acres of mangroves will be planted and 1 acre of oyster habitat will be created as part of the eco-island chain. This complex ecosystem will provide suitable habitat to invertebrates/juvenile fishes, infauna/benthic organisms and migratory birds as well.

There is opportunity for the proposed recommendation to benefit from a value analysis. Based on the scope and complexity of the project, a "Level 2 Abbreviated Study" is recommended during the design phase of the project.

Legal Certification

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017



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CERTIFICATION OF LEGAL REVIEW

The Draft Integrated Feasibility Report and Environmental Assessment for the Lake Worth Lagoon Continuing Authorities Program Section 1135 Study has been fully reviewed by the Office of Counsel, USACE, Jacksonville District and the decision documentation is legally sufficient.

Cem S. Goral
Assistant District Counsel
Date: 17 March 2017

Resubmitted for review and legal certification:

Cem S. Goral
Assistant District Counsel
Date: 20 July 2017

CAP Factsheet

LAKE WORTH LAGOON, CONTINUING
AUTHORITIES PROGRAM (CAP) SECTION 1135
PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

December 2017



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CONTINUING AUTHORITIES PROGRAM PROJECT FACT SHEET

1. Lake Worth Lagoon - Project 447752 - 22nd Congressional District, Representative Lois Frankel (D)

2. Authority

This project is under the CAP Section 1135 of the Water Resource Developmental Act (WRDA) of 1986, as amended, "Project modifications for the improvement of the environment."

3. Location

The study area is located within Lake Worth Lagoon in Palm Beach County, Florida (Figure 1). Lake Worth Lagoon runs parallel to the coast and is separated from the Atlantic Ocean by two barrier islands, Palm Beach Island and Singer Island. It is approximately 20 miles long and up to one mile wide. The Lake Worth Inlet connects the northern part of the lagoon to the ocean and is the entrance channel to the Port of Palm Beach. South Lake Worth Inlet (also known as Boynton Inlet) connects the southern part of the lagoon to the ocean and is primarily used by recreational boaters. The Atlantic Intracoastal Waterway (IWW) runs the entire length of the lagoon. Eight causeways and bridges connect the mainland to the barrier islands.



Figure 1. Map of project location.

4. Problems and Opportunities

a. Problems:

Existing problems within the study area include:

- Freshwater discharges from the C&SF project via canals C-16, C-17, and C-51 induce sudden changes from brackish to low salinity conditions within the lagoon, which can last hours or days. Although these canal discharges to the lagoon provide flood damage reduction benefits for upland urban and agricultural areas within the drainage area, floodwater discharges, particularly from C-51, have the ability to temporarily reduce salinity within the lagoon enough to result in negative impacts on the marine ecosystem.
- Delivery of fine-grained sediments and muck with discharges via canals C-16, C-17, and C-51 gradually cover the natural sands and hard bottom on the lagoon floor, and negatively impact or totally cover oyster beds and other benthic features. These canal discharges transport fine-grained sediments (muck) and attached nutrients (i.e. phosphorous, nitrogen) to the lagoon where they may contribute to water clarity, sedimentation, and algae bloom problems in the lagoon.

b. Opportunities:

Opportunities are positive conditions in the study area that may result from implementation of a Federal project such as:

- To provide ecosystem restoration solutions that create sustainable habitat for marine ecosystem flora and fauna within Lake Worth Lagoon by developing potential ecological solutions that can withstand the impacts of the C&SF project freshwater deliveries and fine-grained muck sedimentation via canals C-16, C-17, and C-51.

c. Objectives to Solve Problems or Realize Opportunities:

The following study objectives were developed based on Lake Worth Lagoon 1135 CAP project problems, opportunities, goals, federal objectives, and state objectives and regulations.

- Maximize sustainable seagrass habitat in project area within 5 years
- Maximize nursery habitat for invertebrates/juvenile fishes in project area within 5 years
- Maximize fish habitat near project area within 5 years
- Maximize recruitment of epifauna/infauna benthic organisms in project area within 5 years
- Maximize bird habitat, including habitat for migratory bird and other wildlife in project area within 5 years

5. Initial Management Measures and Alternative Plans That Have Been Considered – *(If you have used professional judgment to complete any initial screening, describe)*

The main goal of this project is to provide an ecosystem solution that creates a sustainable marine ecosystem habitat for flora and fauna within Lake Worth Lagoon. In order to meet the project objectives, both structural and non-structural management measures looked at ways of satisfying one or multiple project objectives. The following is a list of the structural and non-structural management measures given consideration for meeting this goal:

Non-Structural

- NS-1: adjust/change water control schedule to reduce flows being discharged through the S-155 structure into LWL
- NS-2: divert freshwater flows into a reservoir to reduce accumulation of muck and minimize negative salinity impacts from freshwater pulses

Structural

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat
- S-2: placement of sandy dredge material over muck sediments in dredge hole to create seagrass habitat
- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a 1:8 side slope with armoring at toe
- S-3: removal of muck and placement of sandy dredge material over muck sediments in dredge hole to creation of infauna habitat
- S-4: planting mangroves to create mangrove habitat

A number of management were initially screened out based not fully meeting objectives or avoiding constraints. Reduction of freshwater flows from S-155 (NS-1) was removed by the PDT during preliminary screening because it did not meet the constraints of USACE's flood control mission. Additionally, diverting freshwater flows into a reservoir (NS-2) was also removed by the PDT because it would have been too cost prohibitive to build a reservoir that would positively affect salinity and sediment accumulation in Lake Worth Lagoon under a limited CAP budget. Finally, removal of existing muck and placement of sandy dredge material (S-3) was not carried forward because muck removal from the lagoon proved to be cost prohibitive and no suitable sites for material relocation were found.

Two alternative plans at two sites (Figure 2) plus the no action plan were initially considered, and are described below:

- No Action
- Alternative 1A – The intent of this alternative is to create an island chain at El Cid that will promote mangrove growth while helping to establish and sustain oyster reef development around the islands (Figure 3-1). Island construction will use borrow material from the Peanut Island Dredge Material Management Area (DMMA), located 6.0 miles northeast of the project site. In addition to planting mangrove seedlings and placing pre-fabricated reef modules (2' x 3'), construction efforts will require the installation of rip rap around the islands to protect them from erosive forces due to wave actions occurring within the lagoon. Placement of borrow material from the DMMA will help create the suitable substrate needed for establishing oyster beds and will promote recruitment of seagrass beds around the islands. This alternative will create ~26 acres of suitable habitat for listed species, fish, birds, seagrasses, and other benthic organisms.

The management measures implemented are:

- S-1: placement of rock, gravel on sandy dredge material covering over muck sediments in dredge hole to create oyster reef habitat.
- S-2 Modification: creation of seagrass habitat by placing sandy dredge material over muck sediments in dredge hole site on a low slope with armoring at toe.
- S-4: planting mangroves to create mangrove habitat.

- Alternative 1B – The objective of this alternative is to displace the muck material using fill material exported from Peanut Island 11.8 miles away from the "Bonefish" location. The material will be used to create the habitat for mangrove along with oyster reef environment and possible seagrass. The end state for this alternative is to create couple Islands for mangrove that will be protected with Rip Raps and oyster reef around the islands.
- Alternative 2A – The objective of this alternative is to cap the muck with sand material exported from Peanut Island 6.0 miles away from the "El Cid" location. The difference from this alternative of ALT 1A is the replacement of mangrove Islands with Goliath Reef Balls (6ft x 6ft). The ends state of this alternative is cap in place the muck and create oyster reef habitat.
- Alternative 2B – The objective of this alternative is to cap the muck with sand material exported from Peanut Island 11.8 miles away from the "Bonefish" location. The difference from this alternative of ALT 1B is the replacement of mangrove Islands with Goliath Reef Balls (6ft x 6ft). The ends state of this alternative is cap in place the muck and create oyster reef habitat.



Figure 2. Location of alternative sites.

Alternatives were screened down to Alternatives 1A and 1B based on a cost effectiveness analysis and habitat unit calculations (Table 1 and 2), where Alternative 1B was determined to be the “Best Buy” plan and the NER plan.

Alternative Restoration Plan ID	Plan Cost (ROM)	Average Annual Cost CRF (i=2.875%, n=50)	Construction Duration	Plan Outputs (Habitat Units)	Average Cost per Unit Output	Cost Effective (Yes/No)
No Action Plan	0	N/A	N/A	0	0	N/A
Alternative 1A	\$5,900,000	\$223,900	5 months	13.8	\$16,200	Yes
Alternative 2A	\$6,200,000	\$235,300	5.5 months	4.0	\$58,800	No
Alternative 1B	\$10,500,000	\$398,500	9 months	29.2	\$13,600	Yes
Alternative 2B	\$11,200,000	\$425,000	7 months	8.5	\$50,000	No

Note: Sorted from lowest to highest cost

Table 1. Cost effective analysis for the initial array of alternatives

Alternative Restoration Plan ID	Average Annual Plan Cost (ROM)	Plan Outputs (Habitat Units)	Incremental Habitat Units	Incremental Cost per habitat unit
No Action Plan	0	0	0	0
Alternative 1A	\$223,900	13.8	13.8	\$16,200
Alternative 1B	\$398,500	29.2	15.4	\$13,600
Plan 1 B is the Best Buy Plan and the NER Plan.				

Table 2. Incremental cost analysis of the top two alternatives.

6. Views of Federal, State, and Regional Agencies – (provide letters, emails, Memoranda for Record of meetings, Memo of Phone Conversation, or other documentation indicating that agencies have been contacted and, if available, responses received)

The proposed recommended plan supports the interests of the non-federal sponsor and public. The non-federal sponsor does not wish to pursue a Locally Preferred Plan.

USFWS and NIPHS have been contacted and list of suggested species to be considered have been informally consulted.

These include:

- Smalltooth Sawfish (*Pristis pectinate*)
- Johnson's Seagrass (*Halophila johnsonii*)
- West Indian Manatee (*Trichechus manatus*)
- Hawksbill Sea Turtle (*Eretmochelys imbricate*)
- Leatherback Sea Turtle (*Dermochelys coriacea*)
- West Indian Manatee (*Trichechus manatus*)
- Migratory Birds

Public Notice was sent out 05Oct16 (Attached). Awaiting responses and successful completion of formal coordination with resource agencies contacted.

7. Significant Effects of the Proposed Project – (both positive and negative).

Implementation of the preferred alternative is expected to provide habitat benefits for several species. Seagrasses are expected to naturally recruit, which will provide suitable substrate for benthic fauna. Placement of oyster reef rock and mangroves will provide additional benefits to species by reducing muck accumulation. Besides temporary impacts from construction activities, there are no anticipated negative significant effects of this project.

8. Estimated Schedule and Costs:

- a. Study Schedule

Event	Date (or Projected Date)
SAD Final Review	July 6 th 2017 –November 14th, 2017
SAD final Review and EA approval incorporating signed FONSI (signed at SAJ)	December 7 th – December 22nd, 2017
SAD final report approval and EA/FONSI complete	December 22 nd , 2017

b. Remaining Study Costs

- Mods to Report post SAD Review: \$500
- Coordination w/Agencies: \$4,000

Total: \$4,500

c Project Costs

- **Study Costs To Date including 100% Federal Funds: \$916,000**
- Federal non-cost-shared: \$100,000
- Federal cost-shared: \$410,500
- Non-federal: \$411,000
- **Funds for remaining work - \$4,500**
- Available Federal cost-shared: \$4,500
- Non-federal: \$0
- Remaining Non-Federal WIK required: \$0

Total: \$920,000 (\$820,000 Feasibility, \$100,000 FID)

9. Supplemental Information

- a. Real Estate Summary – Include a concise, summary description of Likely Real Estate interests required for project construction and O&M

Borrow Easement:

A Perpetual and assignable right and easement to clear, borrow, excavate and remove soil, dirt and other materials from (land described in Schedule A) (Tract Nos) beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agent and contractors as a(borrow area) (work area), including right to (borrow and deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the project.

Temporary Work Area Easement:

A temporary easement and right-of-way in, on, and over across (the land described in Schedule A) Tracts Nos, for a period not to exceed, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agent, and contractors as a work area to move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Project, together with the right to trim, cut fell and remove therefrom all trees, underbrush , obstructions, and any other vegetation, structures,

or obstacles within the limits of the right-of-way; reserving, however, to the landowner, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridge the rights and easements hereby required ; subject however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

All of this based on the scope of work.

ii. Preliminary estimated value of LERRD, including incidental and administrative costs.

Estimated RE Admin cost \$ 21,000.00

At present there should be cost for credit because up to \$21,000.

b. Estimated Monitoring Period and Monitoring and O&M costs –

Annual monitoring plan to cover SAV, oyster and mangrove habitat

Annual benthic & terrestrial habitat surveys

Annual photographic evidence demonstrating current state

Change analysis and mapping to illustrate year over year progress

Monitoring Plan will conclude in 5 years at an annual cost of \$35,000 for a total cost of \$158,000

c. Project Specific Legislation and/or Report Language (*if applicable*) – NA