
JUNE 2001

JOHN'S ISLAND
ECOSYSTEM RESTORATION

Palm Beach County, Florida

Section 1135
FINAL ECOSYSTEM RESTORATION REPORT
AND
ENVIRONMENTAL ASSESSMENT

US Army Corps of Engineers
Jacksonville District

FINAL
SECTION 1135 ECOSYSTEM RESTORATION REPORT
AND
ENVIRONMENTAL ASSESSMENT

JOHN'S ISLAND
PALM BEACH COUNTY, FLORIDA

U. S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

JUNE 2001

SYLLABUS

This report provides the results of a feasibility study conducted under the authority of Section 1135 of the 1986 Water Resources Development Act (WRDA) as amended, to environmentally restore John's Island by removing exotic vegetation and dredged material deposits, and to re-establish the native habitats. Section 1135 authorizes the Secretary of the Army to review the operation of Federal water resource projects to determine the need for modifications in the structures and operations of such projects for the purposes of improving the quality of the environment.

The study of John's Island concentrated on modifications to restore approximately 1.7 acres of existing mangroves, planting of approximately 3.3 acres of red mangroves, planting of approximately 1.4 acres of tropical hammock and removal of approximately 5 acres of exotic vegetation. The 1.7 acres of existing mangrove habitat will be restored with the excavation of two tidal inlets, with shore protection.

The environmental benefits consist of restoring approximately 6.4-acres of wetlands and associated upland habitat. The total project cost is estimated to be \$783,680.

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**SECTION 1135
ECOSYSTEM RESTORATION REPORT
AND
ENVIRONMENTAL ASSESSMENT**

**FOR
JOHN'S ISLAND, PALM BEACH COUNTY, FLORIDA**

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SECTION 1135 ECOSYSTEM RESTORATION REPORT JOHN'S ISLAND

INTRODUCTION

This report summarizes a feasibility study on restoring and creating wetland and upland habitats on John's Island in addition to removing exotic vegetation and planting native species. Historically, John's Island was used as a spoil residuary during the dredging of the Intracoastal Waterway. Included in this study are the results of planning, engineering, environmental, economic and real estate studies of the area. The purpose of this study is to determine the Federal interest in the recommendations for restoration of John's Island ecosystem.

STUDY AUTHORITY

This study is being conducted in response to a letter request from the Palm Beach County Department of Environmental Resources Management dated June 8, 1998. This report is submitted under the authority of Section 1135, 1986 Water Resources Development Act (WRDA), as amended by the 1996 Water Resources Development Act. The act reads, as follows:

"The Secretary is authorized to review water resources projects constructed by the Secretary to determine the need for modifications in the structures and operations of such projects for the purpose of improving the quality of the environment in the public interest and to determine if the operation of such projects has contributed to the degradation of the quality of the environment."

STUDY PURPOSE AND SCOPE

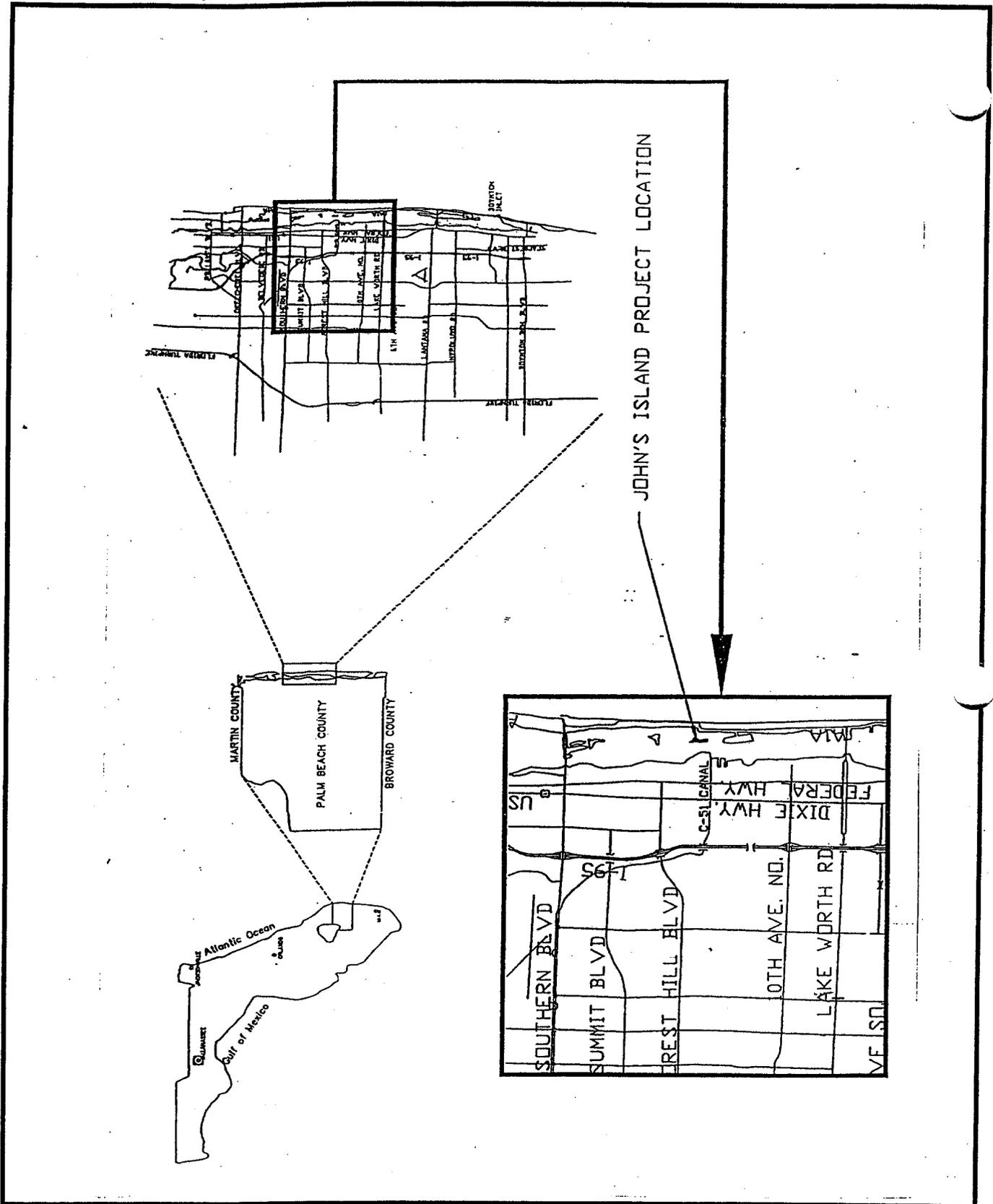
The purpose of this study is to determine the feasibility and Federal interest in modifying John's Island for ecosystem restoration. The recommended plan will be feasible and consistent with the authorized project purposes and will improve the environment.

LOCATION

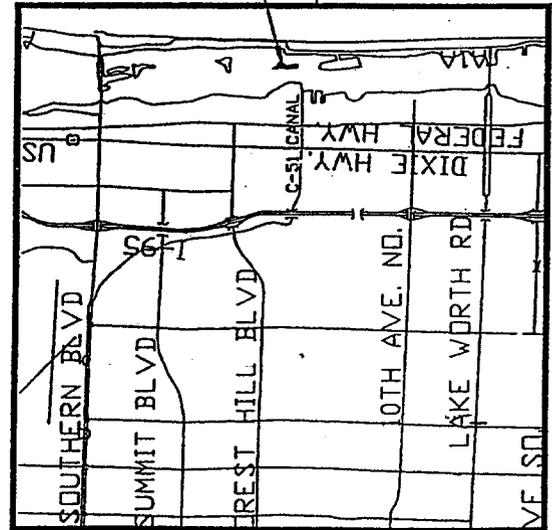
John's Island is an approximately 6.4-acre spoil island owned by the Town of Palm Beach and located in the Intracoastal Waterway (IWW). See Figure 1.

PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

Peanut Island and Munyon Island Environmental Restoration. The Jacksonville District prepared a final Environmental Assessment for Peanut and Munyon Islands. Both projects, sponsored by Palm Beach County Department of Environmental Resources Management, consisted of the removal of exotic vegetation and dredged material deposits to restore wetland and upland areas. The Munyon Island project has been constructed and is being maintained by the sponsor whereas the Peanut Island is undergoing the development



JOHN'S ISLAND PROJECT LOCATION



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 Jacksonville District, Corps of Engineers
 Jacksonville, Florida
 Figure 1
LOCATION MAP - JOHN'S ISLAND
 Section 1135 Ecosystem Restoration Report
 Palm Beach County, Florida

of plans and specifications for construction at this time.

Beach Renourishment Projects. In addition to the aforementioned ecosystem restoration projects, there is a beach erosion control project in the vicinity of Peanut Island, Palm Beach County from Lake Worth Inlet to South Lake Worth Inlet. The shore protection project for Palm Beach County was authorized by Public Law 85-500 on July 3, 1958. The project provides for Federal contribution toward the cost of a local shore protection project. The project consists of initial restoration and future nourishment of a protective beach along the ocean shore of Palm Beach Island and construction and operation of a sand transfer plant at Lake Worth Inlet.

Palm Beach Harbor (Lake Worth Inlet). At a number of points along the east coast, the continuity of the outer barrier land strip is broken by openings and inlets, connecting the IWW with the Atlantic Ocean. Palm Beach Harbor (Lake Worth Inlet) is one such inlet. The inlet was initially dredged up to 18 feet deep and 50 feet wide. Later, it was dredged up to 300 feet in width and protected by two jetties, all of which were constructed by local interests between 1918 and 1925.

Intracoastal Waterway, Jacksonville to Miami. Between 1883 and 1912, the Coast Line Canal & Transportation Company, in a land development navigation improvement agreement with the State, dredged connecting canals between Jacksonville and Miami, so that a continuous inside waterway was created between two cities. This series of artificial canals and natural waterways is now known as the Intracoastal Waterway (IWW) from Jacksonville to Miami, Florida, and is maintained as a Federal/State navigation project, utilizing Peanut Island, 8.7-miles north of nearby John's Island, as a disposal site for local IWW work.

PLAN FORMULATION

Existing Conditions

A topographic survey of John's Island conducted by Palm Beach County in 1998 revealed spoil elevations reaching as high as approximately 6.0-feet. NGVD east of the berm and associated mangroves. It was observed that in many locations within the higher elevations, significant volumes of crushed limestone rock, approximately 4 to 18 inches in diameter are scattered on the surface or partially buried in the soil.

John's Island has a berm running the length of its western side with a maximum elevation of approximately 3.8-feet. NGVD. The berm is bounded along its entire western side by an outcrop of Anastasia limestone, which continues west into the IWW right of way. Old red mangrove stands (30 plus years) are scattered along the berm's eastern slope and adjacent areas.

Approximately 75% of the island is covered by exotic plant species, the remaining 25% is covered by all three species of mangroves (red, white, and black). The island currently has approximately 1.7-acres of mangrove stands that in many places have been invaded by exotic plant species as well. In addition, a few tropical hammock species, including some large strangler figs (*Ficus aurea*), have survived under the canopy of exotics.

Future without project conditions

The island will continue to be dominated by exotic vegetation, primarily Australian pine, Brazilian pepper, and Mahoe. An isolated mangrove forest of approximately 1.7-acres exists on the east side of the island, which is impounded by a sand berm and only flushes at spring high tides. As a result, the exotic plants could dominate the already degraded mangroves and take over the area. This spoil island will continue to no longer be used for storing dredged spoil.

Problems and Opportunities

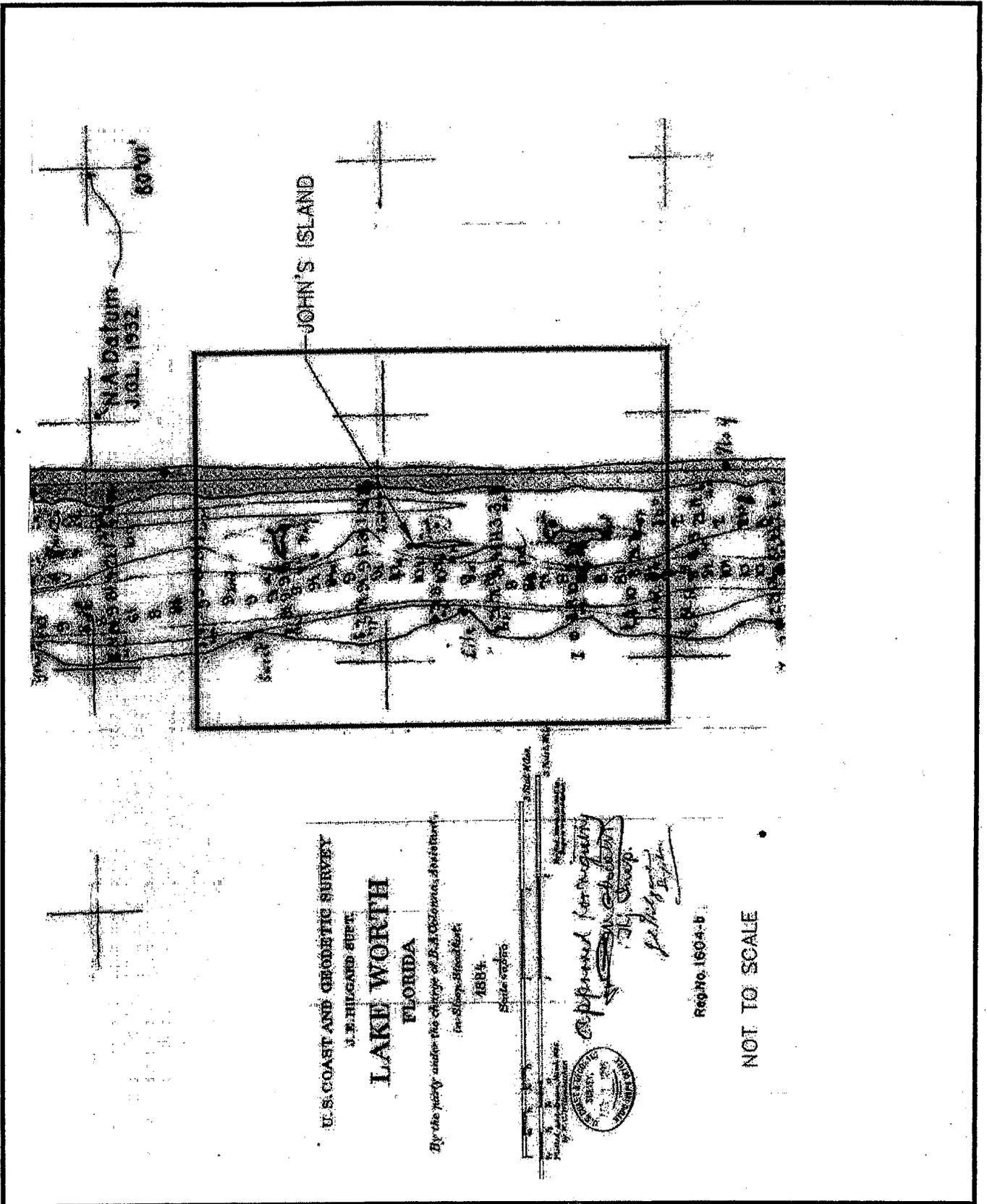
Historically, the area known as John's Island was a submerged shallow water habitat as illustrated in an 1884 U. S. Coast and Geodetic Survey (Figure 2). As a result of the fill placement from numerous dredging projects, the island today comprises approximately 6.4 acres and has become invaded by exotic species such as the seaside mahoe (*Thespesia populnea*) and Australian pine (*Casuarina sp.*).

A 1990 study, Lake Worth Lagoon Natural Resources Inventory and Resource Enhancement Study, performed by Palm Beach County Department of Environmental Resources Management rated John's Island as a high priority site for restoration (Dames and Moore, 1990). Twenty habitats along Lake Worth Lagoon Estuary were selected, identified, and evaluated in order to establish a prioritized list of areas in need of restoration. Evaluation for rating the sites was based on the following criteria: construction resources requirements, maintenance requirements, ecological benefits, land availability, public acceptance, probability for success, and proximity to significant natural resources.

John's Island was selected as a high priority site due to its location on public lands, ecological benefit, and high probability for success. Public acceptance of a restoration project in this area has been extremely favorable, providing that public use of the island is not impeded, but enhanced. In a system that has lost much to development, the ecological benefits to be realized from restoring and creating additional wetland and upland habitat, are significant.

Palm Beach County has more than 100 miles of shoreline with estuarine habitat within the boundaries of the Intracoastal Waterway. Lake Worth Lagoon comprises more than 50% of this estuary and is recognized as one of the area's most important estuarine lagoon systems. Estuaries are among the most productive ecosystems on Earth because of their salt and freshwater interaction and their shallowness compared to open seas. The restoration of John's Island will help rejuvenate this portion of the Lake Worth Lagoon by increasing habitat and food supply for estuarine dependent fauna and flora.

The Florida Department of Environmental Protection (FDEP) has designated Lake Worth Lagoon as an "Ecosystem Management Area." The designation prioritizes the water body and ranks it as an estuary in need of protection and restoration as part of FDEP's Ecosystem Management Areas Plan, 1997. A steering committee has been established which is co-chaired by the Director of FDEP's Southeast District Office and a Palm Beach County Commissioner. Current FDEP Ecosystem Management efforts strive to coordinate the efforts of 30 municipal, state, county, and regional governments that affect or oversee the lagoon. The Lake Worth Lagoon Ecosystem Management Mission Statement is as follows:



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Jacksonville District, Corps of Engineers
Jacksonville, Florida

FIGURE 2

HISTORIC CONDITIONS - JOHN'S ISLAND
Section 1135 Ecosystem Restoration Report
Palm Beach County, Florida

To restore, conserve and manage the Lake Worth Lagoon Ecosystem to a level of quality to obtain measurable and significant improvement to the Lagoon's water and sediment quality; and to provide habitat for native plants, fish, and wildlife, and aesthetic, recreational and economic benefits for the residents and visitors of Palm Beach County; and to encourage, develop and promote a partnership of public and private interests to manage the Lagoon.

Under the sponsor, Palm Beach County's Comprehensive Management Plan and FDEP's Ecosystem Management Plan, the County Department of Environmental Resources Management has identified numerous objectives to restore and protect the lagoon. These objectives included recommendations for habitat restoration, which have been realized with the completion of Munyon Island Ecosystem Restoration Project, the continuing progress of the Peanut Island Ecosystem Restoration Project, and the initiation of the John's Island Ecosystem Restoration Project. The John's Island Ecosystem Restoration Project elements are in direct agreement with the goals of the proposed Ecosystem Management Area Plan for the Lake Worth Lagoon. The John's Island project has been selected to receive local funding through the Lake Worth Lagoon Partnership Program in the amount of \$202,475.

Constraints

John's Island is located approximately 200-feet east of the IWW. The westerly section of the boundaries of the project can not encroach on the IWW. Any construction including rock placement is not allowed within 100-feet from the IWW.

Objectives

Development of objectives for the restoration of John's Island began in 1998 and were based on the joint effort of the Corps' and Palm Beach County's recent environmental restoration of 20-acres of wetland and 25-acres of upland habitat on nearby Munyon Island. The objectives consider the combined interest of the landowners and involved agencies. The developed objectives are listed below:

1. To produce habitat for seagrasses
2. To enhance water quality
3. To create a nursery habitat for invertebrates and juvenile fish
4. To recruit of benthic organisms
5. To create habitat for birds, including migratory birds, and other wildlife
6. To prevent of recolonization of exotic vegetation

Components

A list of components was determined with each component meeting at least one of the objectives. The reason for selecting each component is explained below.

Component 1. Dredging Tidal Channels, Placement of Rip Rap, and Planting Mangroves

This effort will restore and create mangrove habitat and potentially recruit seagrass. Restoration of existing mangroves on the west side of John's Island will be facilitated through the creation of a series of tidal channels. The tidal channels will be excavated and

will be stabilized by placement of rip rap which will limit sediment deposition in the flushing channel entrance and provide protection from storm waves and erosion. The primary purpose of the tidal channels is to provide flushing to the mangrove wetland community. Also, mangroves will be planted around the tidal channels, which will create new mangrove habitat.

Within the wetland habitat created on nearby Munyon Island, Palm Beach County staff has recorded the presence of a number of seagrass and algal species including *Halodule wrightii*, *Thalassia testudinum*, *Halophila johnsonii*, *Halophila decipiens*, *Caulerpa sertularioides*, and *Gracilaria tikvahiae*. The seagrass species *Halophila johnsonii* is currently a threatened species. National Marine Fisheries Service Final Rule listing the grass as a threatened species was published 14 September 1998, 63 Federal Register 49035 (to be codified at 50 C.F.R. Part 227).

Most of the Lake Worth Lagoon shoreline has been altered by dredging, filling, and bulkhead construction. Mangrove communities provide habitat for marine organisms, protect shorelines from erosion, and enhance water quality by acting as natural filters. Detritus material produced by mangroves is the basis of the food chain for South Florida's marine and estuarine ecosystems. An ultimate goal of the proposed restoration project is to optimize the quality of productive wetland habitat to promote fisheries and wildlife. Over 70% of local commercial and recreational fisheries depend upon the mangrove wetland habitat at some time within their lifecycle. Restoration of John's Island will provide an opportunity to restore existing wetland habitat.

Component 2. Filling an IWW Anoxic Hole with Dredge Material

Dredge material will be generated and removed from the island as a result of restoration. The dredged material located on John's Island originated in the vicinity of Lake Worth Lagoon. Analyses of sediment grab samples indicate that the material is suitable for placement within the Lake Worth Lagoon. This material presents an opportunity to restore a dredged area located within the Lake Worth Lagoon. An anoxic dredged site known as the City of Lake Worth Wetland Restoration area, has been identified to accommodate the 17,000 cubic yards of dredge material generated by this project. This amount will only supplement the required 900,000 cubic yards needed to completely fill the anoxic hole. The proposed design elevation has been selected as the desired depth, which emulates surrounding submerged bottom currently supporting mangrove, seagrasses and oyster habitat.

Component 3. Removal of Exotic Vegetation

Removal of this extensive source of exotic vegetation and subsequent seed source will be an immediate benefit to the surrounding area. The efficient use of the exotic vegetation by chipping it on site and utilizing the material as a mulch substrate for upland plants will be a major project benefit both ecologically and economically.

Component 4. Maritime Hammock

Creating a maritime hammock area on John's Island, immediately adjacent to coastal mangrove wetlands, will enhance plant communities and provide wildlife habitat for many species of avian fauna and wildlife which will make use of this area to fulfill their needs for water, food, and cover. The dense canopy of hardwood hammock vegetation will attract a

different component of the wildlife community, especially migratory songbirds. There is tremendous interest in the conservation and management of neotropical migratory birds within the conservation community.

In southern Florida, migrating and overwintering songbirds and raptors depend heavily on the cover and abundant food available in coastal hammocks. Migrating birds use the coastlines as travel corridors, and patches of densely canopied forests are like magnets to these weary travelers. Restoring upland hammock immediately adjacent to coastal mangrove wetlands will enhance both plant communities as well as wildlife habitat, and many species of wildlife will make use of both areas to fulfill their needs for water, food, and cover.

Table 1 displays what components meet what objectives. Alternatives were developed based on the components meeting the objectives.

TABLE 1

OBJECTIVES/COMPONENTS MATRIX							
#	COMPONENTS	OBJ. 1	OBJ. 2	OBJ. 3	OBJ. 4	OBJ. 5	OBJ. 6
1	Dredging tidal channels, placement of rip rap and planting mangroves	X	X	X	X	X	X
2	Filling an IWW anoxic hole with dredge material	X	X	X	X		
3	Exotic vegetation removal					X	X
4	Planting native maritime Hammock vegetation					X	X

DESCRIPTION OF ALTERNATIVES

Alternative A - Restoration and placement of material in an anoxic hole

Alternative A would consist of restoring approximately 1.7-acres of existing mangroves; creating approximately 3.0-acres of red mangroves; creating approximately 1.4-acres of maritime hammock; removing approximately 5-acres of exotic plant species, and placing 17,000 cubic yards of excavated material into an anoxic hole approximately 2 miles south of John’s Island.

Alternative B – Restoration and placement of disposal material in an undetermined location

Alternative B would consist of restoring approximately 1.7-acres of existing mangroves; creating approximately 3.0-acres of red mangroves; creating approximately 1.4-acres of maritime hammock; removing approximately 5-acres of exotic plant species, and placing 17,000 cubic yards of excavated material in an undetermined location.

Alternative C – No Action

With the no action alternative, a project would not be implemented. Future conditions with no action are described in the Future Without Project Conditions section of this report. This alternative would not satisfy the objectives of restoring valuable wetland or upland habitat on John’s Island.

Screening of Alternatives

The alternatives formulated for this feasibility report were evaluated based on their completeness, effectiveness, efficiency, and acceptability in comparison with the project objectives. Each of the alternatives were well thought out during the plan formulation process and evaluated based on their individual merit and their contribution to restoring the ecology of John's Island.

Evaluation of Alternatives

Alternative A

Alternative A provides for the creation of two shallow-water tidal inlets, maritime hammocks and red mangroves. It would also include restoring the existing mangroves on the island and removing the exotic plant species. The creation of the shallow-water habitat and the tidal lagoon will provide a habitat for seagrass beds and juvenile fisheries.

Upland habitat will be created by clearing exotic vegetation that will be chipped on site. The resulting chips will be spread on the ground and used to mulch upland areas. The mulch will preclude the recurrence of exotic vegetation, maintain soil moisture, and supplement nutrients for the native plants and trees to be installed. Excavated material will be placed in an anoxic hole adjacent to John's Island.

This alternative optimizes ecosystem restoration on John's Island. Exotic plant removal and mulching the seed source helps to maximize the probability for project success as well as decreasing the project maintenance. Alternative A satisfies all of the project objectives.

Alternative B

Alternative B is very similar to Alternative A. The difference in the two alternatives is that the 17,000-cubic yards of excavated material would be disposed of in an undetermined area.

Implementing this alternative may require coordination with city, state, and local agencies on a possible location for placement, which may warrant additional plan formulation to determine the Federal interest in pursuing its proposed location and beneficial use. The costs for pursuing this alternative could be significant if a staging area is required and the hauling distance is substantial. Due to this fact, this alternative is not a consideration

Alternative C

Alternative C does not satisfy any of the objectives. Without Federal support, the project could eventually be completed over the years, with a phased project approach, as local or state funding becomes available.

Trade-off analyses

A trade-off analysis refers to a planning methodology commonly used by the Corps of Engineers which usually relies on professional judgment in evaluating a study's alternatives. It also involves the comparison between the trade-off of different plans.

In the John's Island study, this island is very small and the desired concept of ecosystem restoration is very straightforward. The idea is to remove the exotic vegetation, plant native vegetation and create tidal lagoons for wildlife productivity.

There are other alternatives we have discussed in latter sections of this report, which involve a different scale of effort. Despite the numerous evaluation methods the technical team could have been utilized, professional judgement was considered more prudent than any other type of evaluation method.

DESCRIPTION OF RECOMMENDED PLAN

Recommended Plan

The recommended plan, Alternative A will consist of restoring 1.7-acres of existing mangroves, creating of 3.3-acres of red mangroves, restoring 1.4-acres of maritime hammock, removing 5-acres of exotic plant species, and placing 17,000 cubic yards of excavated material in an anoxic hole approximately 2 miles south of the project site.

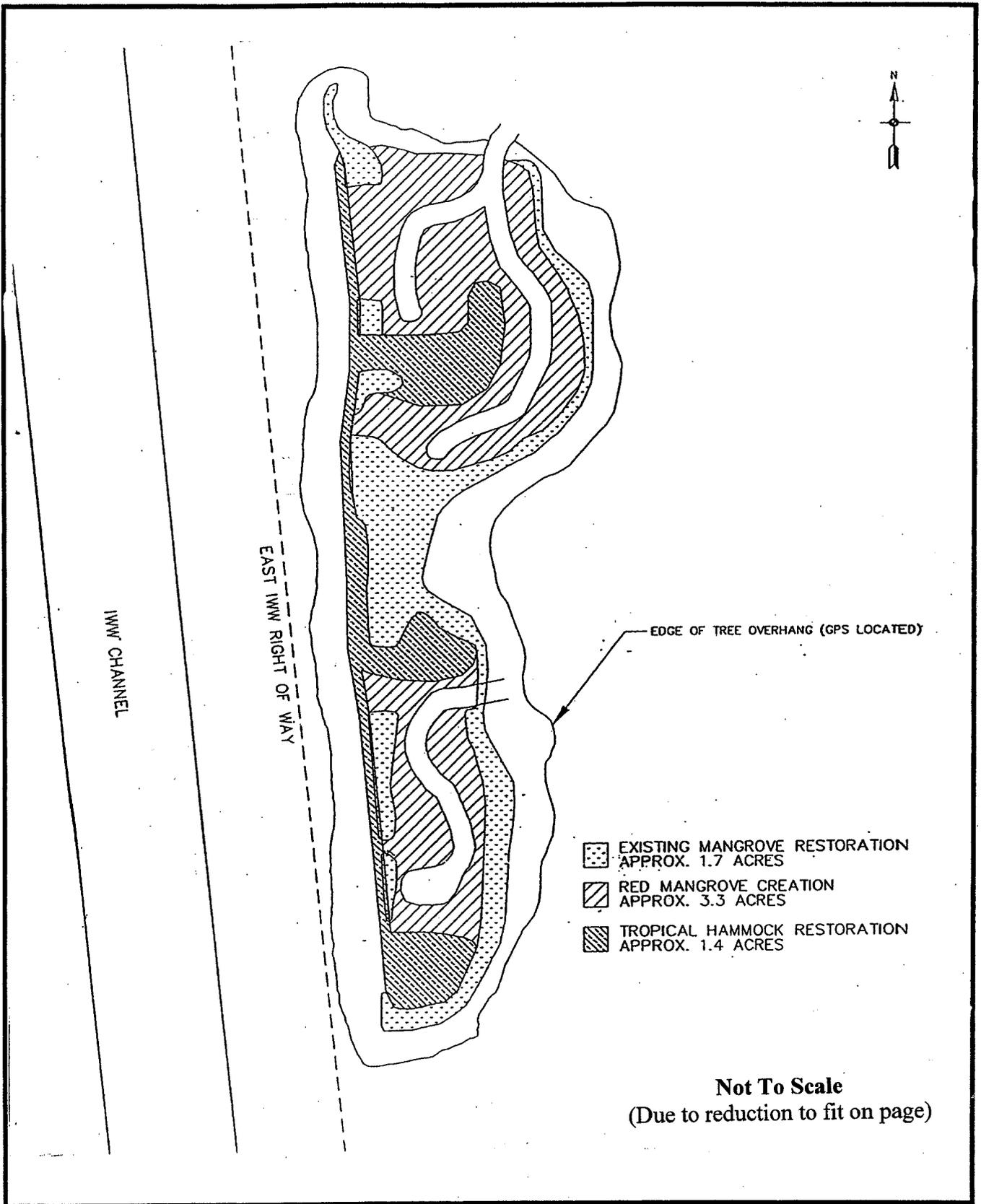
Figure 3 shows the conceptual schematic for the recommended plan. This plan will require constructing a tidal channel system with a total length of approximately a fourth of a mile that will include excavation; grading to wetland elevation, removal of approximately 17,000 cubic yards of material, and placement of approximately 500 tons of 1 to 3 foot diameter boulder rip rap to stabilize the tidal channel inlets.

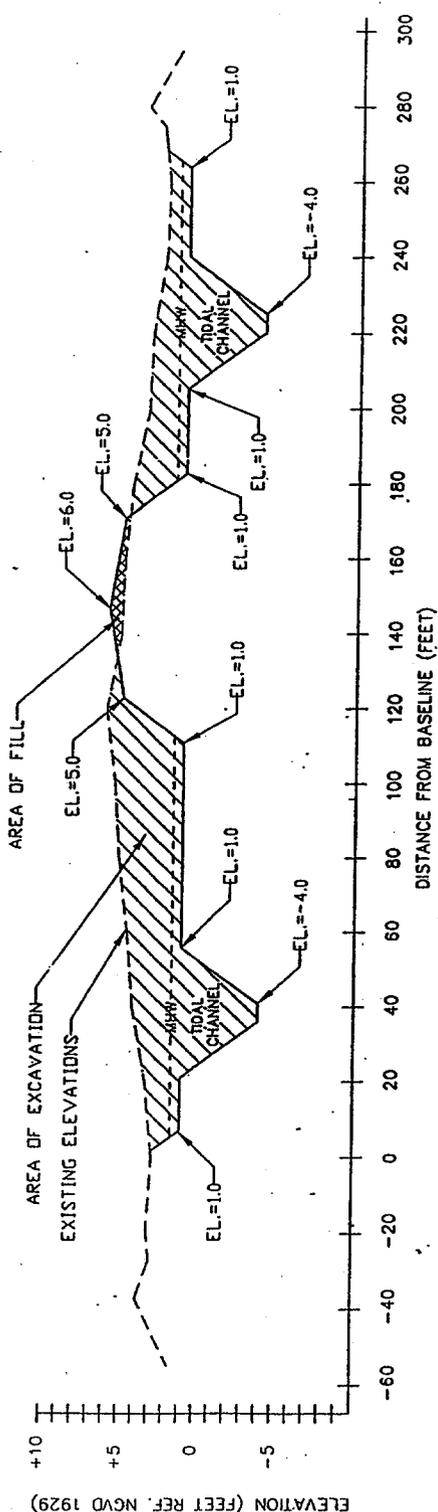
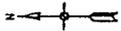
Planting of native vegetation will include approximately 13,800 red mangroves (*Rhizophora mangle*), approximately 11,400 plugs of smooth cordgrass (*Spartina alterniflora*), and approximately 500 maritime hammock plants. Planting will be accomplished with the red mangroves being placed 3-feet on center, the maritime hammock plants placed 7-feet on center, and the smooth cordgrass placed 2-feet on center around the wetland perimeter and the tidal channels. Figures 4 and 5 show cross sections of the planting shelf/tidal channel excavation and planting locations.

Dredge material will be generated and removed from the island as a result of restoration. The dredged material located on John's Island originated in the vicinity of Lake Worth Lagoon. Analyses of sediment grab samples indicate that the material is suitable for placement within the Lake Worth Lagoon. This material presents an opportunity to restore a dredged area located within the Lake Worth Lagoon. An anoxic dredged site known as the City of Lake Worth Wetland Restoration area has been identified to accommodate dredge material. The proposed design elevation has been selected as the desired depth, which emulates surrounding submerged bottom currently supporting mangrove, seagrasses and oyster habitat.

Economic Evaluation

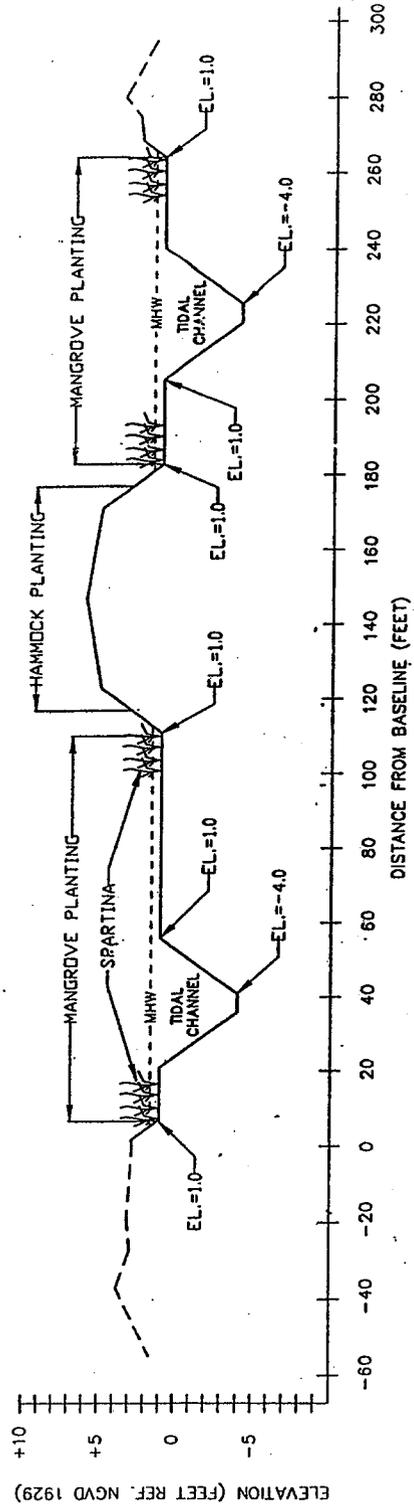
The best plan in an environmental restoration project study is the plan that meets the same general optimization criterion as in a traditional water resources development project whose primary or sole purpose is not environmental restoration. That criterion is maximization of net benefits. Project outputs that are primarily environmental restoration are not expressed monetarily, as a matter of policy. The alternative that maximizes net benefits is the alternative for which the difference between monetary and non-monetary costs and benefits





- NOTES:
- 1) ALL ELEVATIONS ARE IN FEET REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (N.G.V.D.).
 - 2) ALL SLOPES TO GRADE = 3H:1V.
 - 3) SEE FIGURE X FOR SECTION LOCATION.
 - 4) MEAN HIGH WATER (MHW) = 1.6 FT NGVD
 - 5) APPROX. 16,948 CU. YDS. OF SPOIL TO BE EXCAVATED.

DEPARTMENT OF THE ARMY
Jacksonville District, Corps of Engine
Jacksonville, Florida
Figure 4
EXCAVATION LOCATIONS
Section 1135 Ecosystem Restoration Report
Palm Beach County, Florida



- NOTES:
- 1) ALL ELEVATIONS ARE IN FEET REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD).
 - 2) ALL SLOPES TO GRADE=3H:1V.
 - 3) SEE FIGURE FOR SECTION LOCATION.
 - 4) MEAN HIGH WATER (MHW)=1.6 NGVD.
 - 5) 13,800 RED MANGROVES WILL BE PLANTED 3 FEET ON CENTER.
 - 6) 11,400 SMOOTH GRASS WILL BE PLANTED TWO FEET ON CENTER ALONG THE WETLAND PERIMETER AND ALONG TIDAL CHANNELS.
 - 7) 480 TROPICAL HAMMOCK PLANTS WILL BE PLANTED 7 FEET ON CENTER.

is greater than for any other alternative. Benefits and costs for an alternative are the estimated differences between relevant conditions with and without the alternative.

Incremental cost effectiveness analysis refers to the process of demonstrating that the recommended plan is the best plan, the alternative with the largest net benefits. There should be no other plan that accomplishes the same outputs at less cost, no other plan that costs the same and produces more outputs, or any combination of these two scenarios.

For the John's Island environmental restoration project, all benefits are non-monetary environmental improvement benefits that contribute to the national ecosystem restoration goals. Costs are the monetary costs of implementation and OMRR&R. The recommended plan was carefully designed and formulated by a focused interdisciplinary team of professional planners, engineers, and scientists. It is a relatively straightforward, simple plan to remove exotic vegetation and dredged material deposits, thereby re-establishing native habitat on the 6.4-acre island. A good incremental analysis issue worth addressing is whether smaller versions of the recommended plan, most likely less costly, albeit with less output, would be incrementally more cost effective. In a relatively small project like this, such alternatives can be easily rejected for two main reasons. First, the difference in costs between a partial restoration and complete restoration is relatively minimal, mainly because mobilizing resources for the project is the most significant part of the effort, and any meaningful alternative would require this same mobilization effort. Second, a partially restored John's Island would not have as much environmental restoration output, and would make it easy for the remaining exotic vegetation to spread to the restored area without costly, persistent management and maintenance activities over time. Serious consideration of such smaller scale alternatives doesn't make sense. Outputs are composed of the quantity and quality of desired ecosystem resource improvements.

There are legitimate different alternatives for disposal of excavated material. The disposal option for the recommend plan is less costly than any other option. The recommended disposal site is the closest realistic option, and the least environmentally disruptive.

In view of the issues outlined above, the recommended plan is the best and incrementally most cost effective way to achieve the proposed ecosystem restoration on John's Island.

Navigation

The implementation of the recommended plan will not adversely impact navigation in the IWW. Most of the work will be performed on the uplands. As stated under the constraints section, the project site is 200 feet east of the IWW and construction is not allowed within 100 feet from the IWW.

Geotechnical

Preliminary investigations indicated that the 17,000 cubic yards of dredge material is suitable for placement in the City of Lake Worth Wetland Restoration area. Additional information on the subsurface investigations is located in Appendix A of this report.

Water Quality

The recommended plan will not adversely impact water quality in the IWW. The State of Florida Water Quality Certificate conditions will be met during construction of the project.

Fish and Wildlife

The recommended plan will benefit fish and wildlife resources in the project area. Bird utilization will increase due to the desirable feeding, nesting, and diversity in plant species. Fisheries will also benefit due to the anticipated increase in shallow water habitat in and around the tidal lagoons.

Threatened and Endangered Species

In accordance with Section 7 of the Endangered Species Act and Fish and Wildlife Coordination Act, an assessment of potential impacts of the proposed work on threatened or endangered species was prepared. The West Indian manatee (*Trichechus manatus*) and the Johnson's seagrass (*Halophila johnsonii*), a federally threatened species, are located in the vicinity of the project site and the proposed project is not likely to adversely affect these species.

Cultural Resources

John's Island was created as a result of the disposal material from the IWW. It is the Corp's determination that cultural resources included in or eligible for inclusion in the National Register of Historic Places are not likely to be located within the environmental restoration area. To confirm this determination, a cultural resource survey will be performed during the pre-construction, engineering, and design phase to insure that no prehistoric archaeological resources are present.

Hydraulic Information

The hydraulic characteristics of Lake Worth Lagoon have been greatly altered from historic conditions by changes in tidal influence and freshwater inflows. John's Island is located in Lake Worth Lagoon Estuary, which is designated as a Class III water.

The tides are semidiurnal, having two high and two low water levels per day with little inequality. The tide gauge in close proximity to the project area is Gauge No. 872 2654 which is located in the West Palm Beach Canal (C-51).

Mean High Water: +1.69 feet NGVD
Mean Low Water: -0.82 feet NGVD
Mean Tidal Range: 1.43 feet NGVD

The Canal 51 (C-51) is the largest inflow discharging an average of 356 million gallons per day. 75% of the discharge flows north and reaches the Lake Worth Inlet within five days. 25% flows south and reaches South Lake Worth Inlet within nine days (SFWMD, 1977). The maximum residence time of the water body between the two inlets is approximately 14 days (Chiu et al., 1970). Miscellaneous hydrological and hydraulic facts for Lake Worth Lagoon are presented in Table 2 (Dames and Moore, 1990).

HYDROLOGICAL FACTS

1. Surface area of Lake Worth, including the bays is 2.64×10^8 feet².
2. Surface area of Lake Worth between the two inlets is 1.96×10^8 feet².
3. Volume of water below mean sea level, including the bays is 2.1×10^9 feet³.
4. Volume of water below mean sea level between the inlets is 1.73×10^9 feet³.
5. Average rainfall is 5.4 feet/year, a characteristic daily rainfall during the wet season is 1 inch/day.
6. Typical evaporation rates are 0.05 inches/day during the winter, 0.22 inches/day during the summer (computed by Lee, 1975 for Card Sound, a lagoon on the Atlantic coast of Florida approximately 100 miles south of Lake Worth).
7. An estimate of 281 cfs for the groundwater inflow was calculated for September 1974 and 1975 by J. van de Kreeke et al. 1976.
8. The residence time of completely mixed pollutants - The time interval required to replace 50% of the resident water (half-life) is about two tidal cycles (or one day) and the pollutants are reduced to 10% of the original concentration in 6 to 8 tidal cycles (or 3 to 4 days).
9. The residence time of stagnant pollutants - A particle was found to have a net drift of about 3000 feet per tidal cycle southward. A net inflow of about 2×10^4 feet per tidal cycle per foot width was found to be associated with this net drift. In this case, the maximum residence time of the water body between the two inlets would be about 14 days. (Chiu et al. 1970)
10. Salinity variations in Lake Worth correspond closely to the seasonal variations in the fresh water inflow. The importance of groundwater inflow is illustrated by the salinity of 34 ppt during April, 1975 at Southern Boulevard Bridge compared to the ocean salinities of 36 ppt and higher when other freshwater sources were negligible. Salinity profiles along the length of Lake Worth (on 9/18/74) show a minimum of halfway between the two inlets. North of the West Palm Beach Canal, the salinity distribution oscillates over a distance approximately equal to the tidal excursion. Vertical salinity stratification is most pronounced south of the West Palm Beach Canal. (J. van de Kreek et al. 1976)
11. Friction factor (F) values in Lake Worth varied from 0.002 in the wider and deeper parts to 0.017 in the constrictions. The values of the friction factors are higher than the often recommend literature value $F = 0.0025$. A simplified one-dimensional analytical model yielded an overall friction factor of $F = 0.017$. The reason for these high values is the irregular bathymetry, in particular the constrictions, leading to a three-dimensional flow pattern (J. van de Kreeke et al. 1976).

Freshwater inflows to Lake Worth Lagoon according to South Florida Water Management District, 1977, are:

West Palm Beach Canal (C-51)	49.7%
Earman River	12.1%
Boyton Canal (C-16)	10.7%
Surface Runoff	4.1%
Groundwater	22.3%

There was no hydrodynamic modeling performed for the John's Island feasibility effort. The design concept for this island is very similar to both that of Munyon and Peanut Island projects as described in the Prior Studies, Reports, and Existing Water Project section of this report. Unlike John's Island, hydrodynamic modeling was performed on Peanut Island due to its location within the throat of Lake Worth Inlet and it being subjected to much more currents, waves, and large vessel wakes, so the modeling effort was deemed appropriate. Palm Beach County Department of Environmental Resources Management is aware of this design decision as well as their Operation and Maintenance responsibilities.

It is not anticipated that the inflows into the Lake Worth Lagoon from C-51 will have an impact on the design and function of John's Island restoration project.

Construction Methods

The exotic plant clearing and removal of dredged material from John's Island will be conducted using standard equipment and practices. It is anticipated that the removal of the exotic species will have a direct benefit to the seed source. The exotics will be chipped on site and the resulting chips will be used as mulch substrate to prepare the area for revegetation by precluding the reoccurrence of exotic vegetation. The area will be then revegetated with native maritime hammock species, which will provide valuable and more suitable habitat for birds and wildlife. Since portions of the project area will be tidally inundated, the tidal lagoons, flushing channels, and shallow-water reef/lagoon habitats will be stabilized with boulder riprap with tidal connections being made only after final elevations have been achieved and designed features are in place. Turbidity curtains will be utilized when making tidal connections per water quality certificate.

Construction Cost Estimate

MCACES was used to calculate the construction cost estimate for the proposed John's Island Ecosystem Restoration Project, located in Appendix A. The cost estimate is based on quantities derived from preliminary studies and the local sponsor's successful record of environmental restoration throughout Palm Beach County, including the completion of the 20-acre wetland and 25-acre upland restoration on nearby Munyon Island. In addition, the County has created over 40 reef habitats in the coastal and inshore waters of Palm Beach County. The proposed construction and non-construction costs are compiled in Table 3.

TABLE 3

CONSTRUCTION AND NON-CONSTRUCTION COST ESTIMATE					
FOR JOHN'S ISLAND ECOSYSTEM RESTORATION					
	Quantity	Unit	Sub-Total	Contingency	Total Cost
Construction Costs					
Mobilization and Demobilization			\$ 61,670	\$ 12,330	\$ 74,010
Clearing	5	Acres	\$ 8,770	\$ 1,750	\$ 10,530
Limestone Boulders	500	Tons	\$ 21,680	\$ 4,340	\$ 26,010
Chipping	5	Acres	\$ 7,390	\$ 1,480	\$ 8,870
Excavation	17,000	Cubic yards	\$113,160	\$ 22,630	\$ 135,790
Temporary Loading Dock			\$ 40,050	\$ 8,010	\$ 48,060
Tropical Hammocks	500	Each	\$ 69,040	\$ 13,810	\$ 82,850
Cordgrass	11,400	Each	\$ 18,630	\$ 3,730	\$ 22,350
Red Mangrove	13,800	Each	\$ 34,300	\$ 6,860	\$ 41,150
Sub-Total Construction			\$374,680		
Contingencies (20%)				\$ 74,940	
Total Construction Cost					\$ 449,620
Non-Construction Costs					
Real Estate Administrative Cost			\$ 10,000	\$ 2,000	\$ 12,000
Pre-construction, Engineering and Design			\$148,000	\$ 29,600	\$ 177,600
Construction Management			\$ 43,720	\$ 8,740	\$ 52,460
Sub-Total Non-Construction			\$201,720		
Contingencies (20%)				\$ 40,340	
Total Non-Construction Cost					\$ 242,060
TOTAL CONST. & NON-CONST. COST			\$576,400	\$ 115,280	\$ 691,680

PLAN IMPLEMENTATION

Construction Costs

Construction costs include the engineering and design necessary for the project, preparation of contract plans and specifications, supervision and contract administration, construction monitoring, and cost for all temporary or permanent construction easements for lands, easements, rights-of-way, relocations, borrow areas, and disposal areas.

The cost estimate includes 20% percent for project contingencies and 9% for construction management.

Operation and Maintenance Cost Estimate

Operation and Maintenance of John's Island identified in Table 4 will be performed quarterly by the sponsor utilizing a South Florida Water Management District permit.

TABLE 4

OPERATION AND MAINTENANCE COSTS	
THREE YEAR POST CONSTRUCTION OPERATION AND MAINTENANCE COSTS	
	Estimated Cost
Quarterly Maintenance	
Exotic Plant Removal=144 hours/year @ \$35/hour	\$ 5,040.00
Boat Time=6 days/year @ \$250/day	\$ 1,500.00
Herbicide Cost	\$ 1,000.00
Plant Mortality Replacement=16 hours/year @ \$55/hour	\$ 880.00
Boat Time = 2 days/year @ \$250/day	\$ 500.00
Quarterly Monitoring	
Staff time = 64 hours/year @ \$55/hour	\$ 3,520.00
Boat Time = 4 days/year @ \$250/day	\$ 1,000.00
TOTAL O & M Costs/Year	\$ 13,440.00

Real Estate Requirements

The recommended plan consists of removing exotic vegetation, excavating dredge material to create tidal pond/flushing channels, planting mangroves and smooth cordgrass, placing rip rap to stabilize the tidal channel inlets and disposal of excavated material a nearby hole adjacent to Lake Worth Golf Course.

The U.S. Army Corps of Engineers created John's Island by previous dredging events, therefore, the island is within the navigable waters of the United States and is available to the Federal Government directly by the navigational servitude. The dredge material will be placed in a disposal site, which is also submerged and covered under navigational servitude, therefore, no additional lands or interests are required (See Plate A-3).

Environmental Assessment

A draft Environmental Assessment (EA) was prepared by the Corps and is included in Appendix B of this report. The draft EA meets the requirements of the National Environmental Policy Act.

Project Cooperation Agreement (PCA)

The description of the Federal and non-Federal responsibilities will be legally defined in the project cooperation agreement. The purpose of this agreement is to ensure that the non-Federal sponsor will have a clear understanding of the type of agreement it will be expected to sign prior to the start of construction. The Recommendations section of this report describes the items of local cooperation that the non-Federal sponsor will be required to furnish.

PCA negotiations with the non-Federal project sponsor may be conducted, and the draft PCA package is submitted to the higher authority for review and approval once the feasibility report is approved and the project is budgeted for construction. The Chief of Engineers will not allocate Federal construction funds for the project until the Government approves the non-Federal sponsor's financing plan and the PCA is executed.