



**STATEMENT OF FINDINGS FOR EXECUTIVE ORDER 11990
(PROTECTION OF WETLANDS)**

**CAPE SABLE CANALS DAM RESTORATION PROJECT
EVERGLADES NATIONAL PARK**

August 2009

Recommended:

Dan B. Kimball, Superintendent, Everglades National Park Date

Certified for Technical Accuracy and Servicewide Consistency:

Bill Jackson, Chief, NPS Water Resources Division Date

Approved:

David Vela, Southeast Regional Director Date

1.0 INTRODUCTION

The National Park Service (NPS) has prepared and made available for public review, an Environmental Assessment (EA) for the Cape Sable Canals Dam Restoration Project. This project is intended to provide sustainable solutions to issues associated with saltwater intrusion into and degradation of freshwater and brackish marshes north of the marl ridge; illegal motorized boat access into the Marjory Stoneman Douglas Wilderness area; and unsafe conditions for motorized and non-motorized boaters at the dam sites. The EA and this Statement of Findings (SOF) would provide decision-makers with sufficient information to decide whether restoration/construction of the dams at the East Cape Extension and Homestead canals in the Cape Sable area of Everglades National Park is worth the financial cost and potential environmental effects associated with construction. The NPS is the lead agency for preparation of this SOF.

The National Park Service (NPS) has long recognized the importance of addressing impacts from the Cape Sable canals. Stopping tidal flow into the cape's interior marshes is the key to revitalizing the function of these freshwater marshes. While this landscape is naturally dynamic, slowing the rate of change on this landscape may also bring about greater resilience to the cape in the face of predicted sea level rise and the possibility of more frequent and intense hurricanes.

The NPS plugged several of the canals at the marl ridge with earthen dams in the late 1950s and early 1960s. Over time, natural forces compromised two of these early structures and, by 1992, they had failed. The earthen dams were replaced in 1997 with sheet-piling dams, though these also failed after a few years, possibly due in part to vandalism, which increased erosion of the canal banks. Openings at the failed plugs continue to widen, due to erosional processes, and transport marine waters eastward along the Homestead Canal as far as Bear Lake. These structures are located along the East Cape Extension and Homestead canals (see Figure 1.1 for the locations of the failed dam sites and Figures 1.2 and 1.3 for aerial views of the East Cape Extension and Homestead canals' dam site).

Due to the need to minimize or stop tidal flow to the interior marshes of the cape, the NPS retained URS Corporation to conduct a Preliminary Engineering Analysis in 2007 to identify and develop preliminary engineering design concepts for the restoration of the failed dams on the East Cape Extension and Homestead canals. Upon completion of the preliminary study, the no action (represents the current condition) and viable action (build) alternatives for each canal were carried forward in the EA and SOF to analyze the impacts that would potentially result from implementation of these alternatives, in accordance with all applicable laws and policies. The remoteness of both dam sites and the difficulty in accessing the dam areas on the East Cape Extension and Homestead canals would have significant impact on the repair alternatives that have been developed as well as the associated costs.

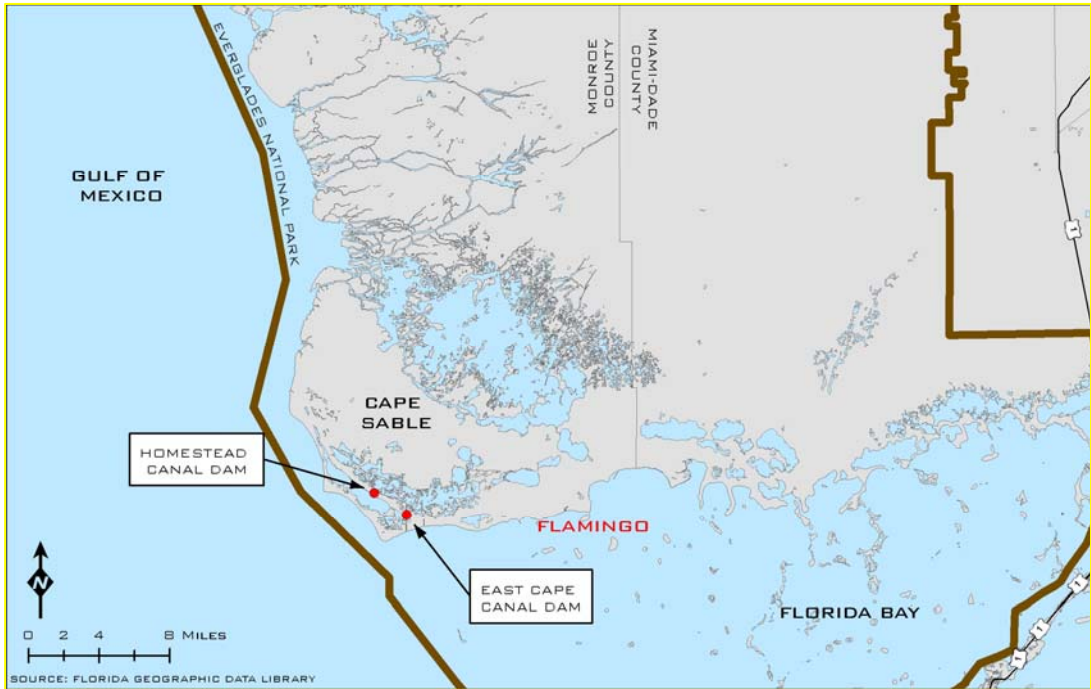


Figure 1.1 - Failed Dam Locations



Figure 1.2 – Aerial View of East Cape Extension Canal Failed Dam



Figure 1.3 – Aerial View of Homestead Canal Failed Dam

Executive Order 11990 (Protection of Wetlands) requires the NPS, and other federal agencies, to evaluate the likely impacts of actions in wetlands. The objectives of the Executive Order are to avoid, to the extent possible, the long-term and short-term adverse impacts associated with occupancy, modification, or destruction of wetlands, and to avoid indirect support of development and new construction in such areas, wherever there is a practicable alternative. The purpose of this SOF is to present the rationale for implementation of the proposed project in the wetlands of Everglades National Park and to document the anticipated effects on these wetland resources.

2.0 WETLANDS OF THE CAPE SABLE AREA

Cape Sable is located at the southwest corner of the Florida mainland. It is bordered by Florida Bay to the south, the Gulf of Mexico to the west and Whitewater Bay to the northeast. It is connected to the mainland by an easterly-trending marl ridge, at the southernmost end of the “river of grass” that makes up the Everglades ecosystem. It is located between the outlets of two major watersheds of the Everglades National Park: Shark River Slough and Taylor Slough. Shark River Slough flows from its origin in the northeast portion of the park and empties into the Gulf of Mexico to the west of Cape Sable, while Taylor Slough drains a smaller watershed along the eastern portion of the park and flows into northeastern Florida Bay (NPS 2003). The study area is at elevations near sea level and, given its location in relation to the sloughs, is subject to the overland flow that defines the park’s regional water system. Surface waters located within the Cape Sable study area include several manmade canals, natural tidal creeks and Lake Ingraham.

The majority of the land in the Cape Sable area is classified as wetland habitat, an integral component of the Everglades National Park landscape. Wetlands of the greater Everglades ecosystem include a mosaic of vegetation types, including tree-islands, mangrove forests, cypress swamps, marl prairies, sawgrass marshes, and sloughs (USGS 2007). Figure 2.1 shows the approximate limits and wetland classifications of each distinct wetland type within the Cape Sable study area, based on available National Wetland Inventory (NWI) Geographic Information System (GIS) data layers (USFWS 2007). The “E2” wetlands are estuarine intertidal wetlands. The “SS3” wetlands are broad-leaved evergreen scrub-shrub wetlands, consisting mainly of mangrove vegetation that has had stunted growth due to the effect of hurricanes. The “EM” wetlands consist of emergent coastal prairie and salt marsh vegetation such as saltwort and other salt-tolerant plants and marsh grasses, primarily *Spartina* species. The adjacent Florida Bay, where access to Cape Sable would originate under any alternative, is classified as an estuarine subtidal habitat with aquatic beds of unknown substrate characteristics.

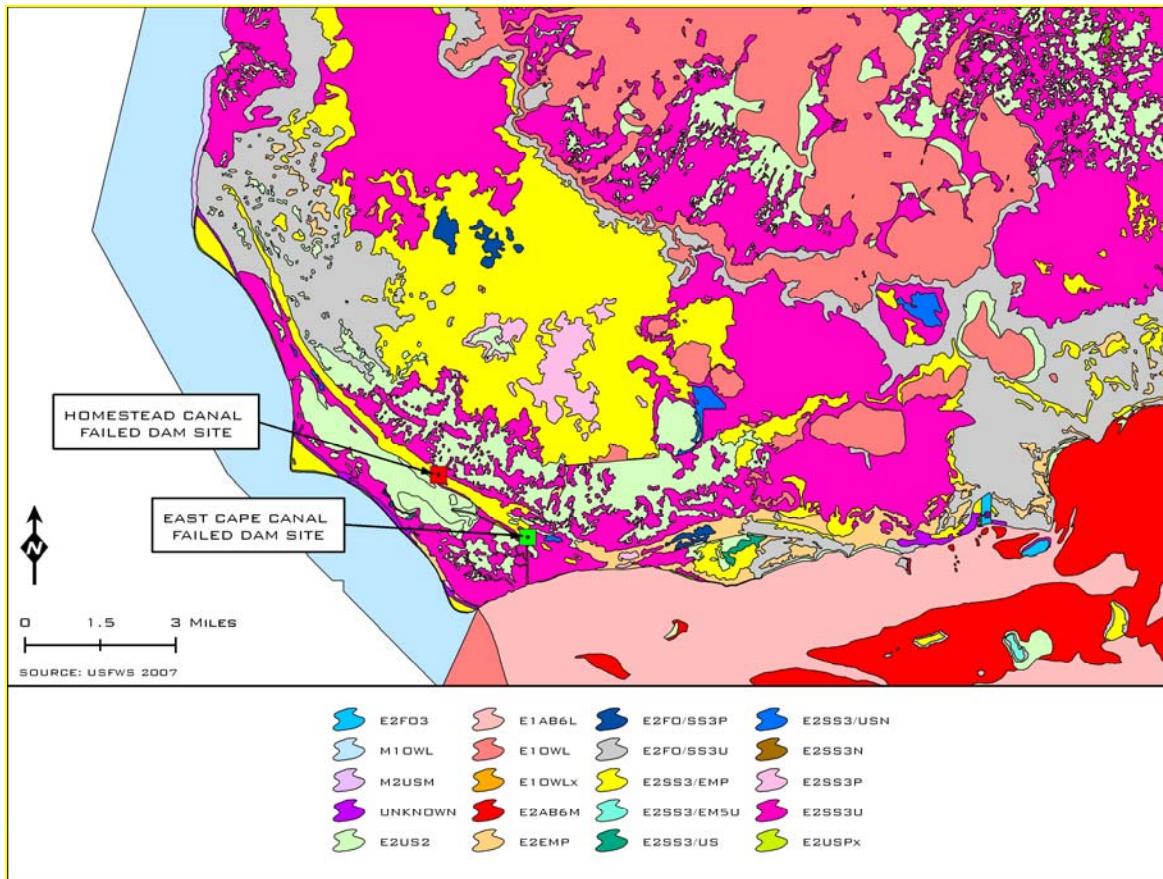


Figure 2.1 – NWI Classifications of Wetlands in Cape Sable Study Area

Prior to canal construction, the interior of Cape Sable consisted predominantly of freshwater marsh intermixed with brackish marsh. The marl ridge (shown in Figure 2.2, below) provided a continuous boundary between Florida Bay/Gulf of Mexico and the interior areas of Cape Sable from Flamingo west to Clubhouse Beach where the marl ridge turned northwestward and continued north of Lake Ingraham and emerged at the coast north of North Cape and Little Sable Creek.

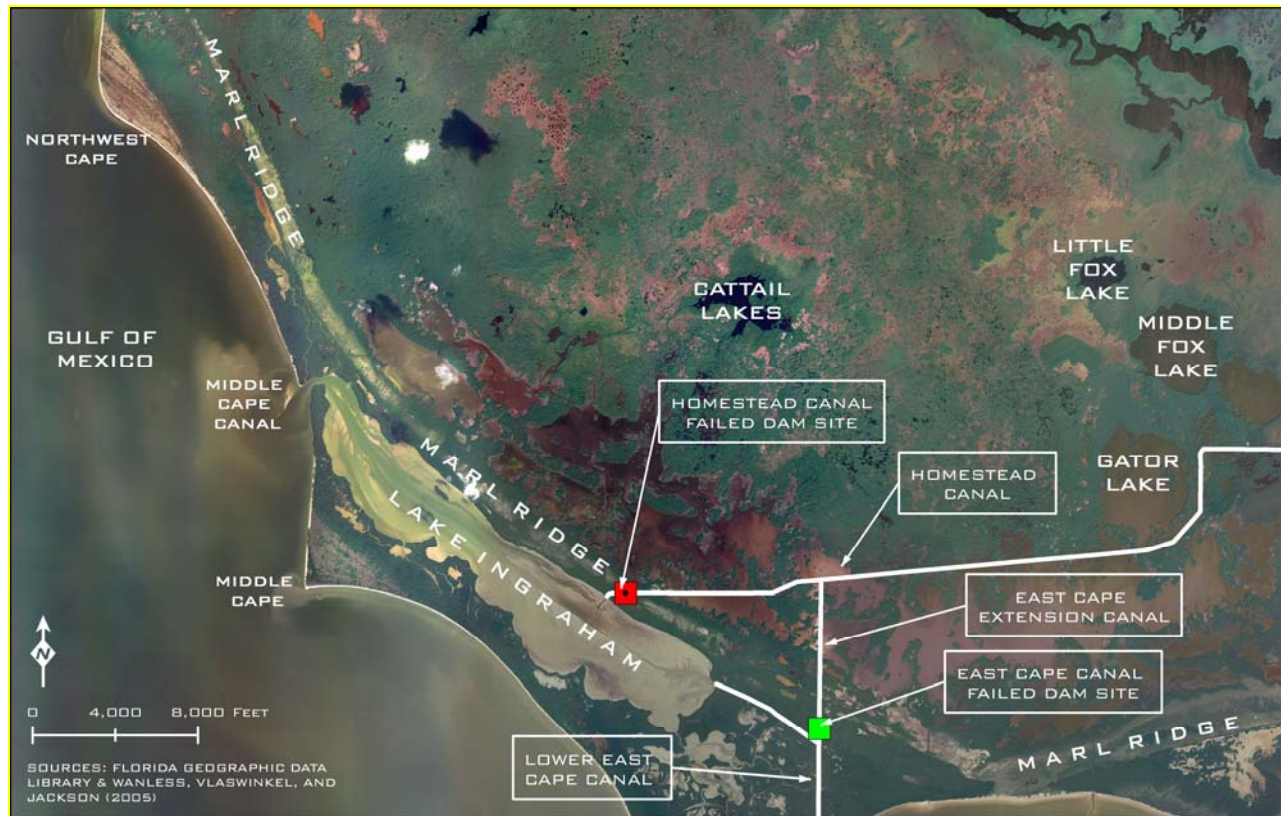


Figure 2.2 – Approximate Location of Marl Ridge

Along the Gulf of Mexico, the Cape Sable coast consists of a mangrove wetland with a series of penetrating tidal creeks running inland for approximately 1-2 miles. These penetrating tidal creeks extend along the north side of Cape Sable but fade as the shoreline turns southeastward along the shore of Whitewater Bay. The mangrove coastline typically yielded to inland brackish and freshwater marsh wetlands within 1,000 feet at most. It appears the freshwater from local rainfall and overland flow limited mangrove and other marine communities from further encroaching inland.

Canal construction appears to have had a dramatic effect on the southern portion of the interior of Cape Sable. By 1953, the higher marl areas became colonized by mangroves. According to Wanless and Vlaswinkel (2005), the collapse of the southern interior marsh was a direct result of the lowering of the marsh with construction of the East Cape, Homestead and Middle Cape canals through the marl ridge; large storm events/hurricanes (e.g., the 1935 Labor Day Hurricane was described as sending a six-foot storm surge across Cape Sable eliminating forested wetlands adjacent to Lake Ingraham, Hurricane Donna was described as lifting up whole areas of mangrove forest and moving those, creating instant new islands, Hurricane Andrew described as crumpling and rolling up large areas of marsh); and saline intrusion through the constructed canals. Since 1953, the areas of open water have continued to gradually expand northward and the areas colonized by mangroves have progressed. In addition, the central and northern interior freshwater marsh communities of Cape Sable are interspersed with mangroves and other marine community vegetation. Peat soil is lost and fresh water marsh communities are

being replaced by open water saline communities. This process has been accelerated on Cape Sable by saltwater moving through the Homestead and East Cape Extension canals where the dams have failed. The open canals and at least one “natural” tributary, East Side Creek, transport sediment and organic material from interior marshes to Lake Ingraham where much of this material has been deposited. Sediment, and probably nutrients, from the collapsed marsh also make their way to Florida Bay and the Gulf of Mexico.

Detailed characterizations of wetland/surface water areas located within and adjacent to the Cape Sable study area are as follows:

Lake Ingraham – Embayment opening directly into Gulf of Mexico / Tidal Flats (FLUCFCS – 541 / 651)

USFWS – E2USM/N (Estuarine, Intertidal, Unconsolidated Shore, Irregularly Exposed / Regularly Flooded)

Lake Ingraham is a shallow, intertidal embayment approximately 5 miles in length by 0.5 mile in width with the long axis trending northwest/southeast. This shallow embayment (3-5 feet in water depth) is separated from the marine waters of the Gulf of Mexico and Florida Bay by a narrow carbonate sand beach ridge and barrier beach, and from the interior Cape Sable complex of mangrove wetlands and numerous shallow subtidal open water areas by an emergent calcium carbonate marl ridge. Several manmade canals and natural tidal creeks provide access to the lake and function as tidal inlets enhancing tidal flow into and out of the lake. The expansion of the East Cape and Homestead canals has exacerbated sediment deposition in the interior marshes and is converting Lake Ingraham into a tidal mud flat. Today, the flood tidal delta in Lake Ingraham forms a sediment body over 2.5 miles over the entire width of the lake and is 2-3 feet thick resembling an emergent system at low tide (Wanless and Vlaswinkel 2005). The sedimentation allows for the growth of abundant surface algal and cyanobacterial mats on the substrate as well as providing suitable habitat for the colonization of red mangrove (*Rhizophora mangle*) seedlings.

Homestead Canal Dam – Mangrove Swamp / Saltwater Marsh (FLUCFCS – 612 / 642 / 512)

USFWS – E2SS3P (Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Irregularly Flooded), E2EMP (Estuarine, Intertidal, Emergent, Irregularly Flooded) and E1UBLx (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal, Excavated)

The Homestead canal was constructed in the 1920’s and cuts across the marl ridge in a low area entering Lake Ingraham on its northeast shore. The permanently flooded canal was originally excavated for development purposes and as a borrow area for fill material needed for the construction of the old Ingraham Highway. The substrate of the excavated canal is comprised of an approximate 13-foot layer of marl underlain by approximately one foot or less of peat followed by limestone bedrock. No submerged vegetation exists within the waterway itself possibly due to strong tidal currents. The canal banks are comprised primarily of regularly flooded mangrove wetlands dominated by red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*) with a sparse to dense groundcover dominated by saltwort (*Batis maritima*) and bushy seaside oxeye (*Borrchia frutescens*) adjacent to Lake Ingraham transitioning northward to a more elevated, irregularly flooded buttonwood (*Conocarpus erectus*) and

saltwort (*Batis maritima*) dominated wetland in the vicinity of the Homestead Canal failed dam. The buttonwood-saltwort community dominating the marl ridge consists of a mosaic of dense to open canopy buttonwood and open areas with a sparse to dense groundcover of saltwort.

A slightly elevated relict spoil bank persisting from the construction of the canal extends eastward along the south bank of the canal from Lake Ingraham. The plant community inhabiting the spoil bank is comprised of a mosaic of estuarine wetland species, halophytic species, and plants that require less hydric conditions than those found in the surrounding mangrove and buttonwood-saltwort communities. In addition to buttonwood, saltwort, and bushy seaside oxeye, common species inhabiting the spoil bank include gray nicker (*Caesalpinia bonduc*), Portia tree (*Thespesia populnea*), white stopper (*Eugenia axillaris*), white indigoberry (*Randia aculeata*), common wireweed (*Sida ulmifolia*), moonflowers (*Ipomoea alba*), pricklypear (*Opuntia humifusa*), and triangle cactus (*Acanthocereus tetragonus*).

East Cape Extension Canal Dam – Mangrove Swamp / Saltwater Marsh (FLUCFCS – 612 / 642 / 512)

USFWS – E2SS3P (*Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Irregularly Flooded*), E2EMP (*Estuarine, Intertidal, Emergent, Irregularly Flooded*) and E1UBLx (*Estuarine, Subtidal, Unconsolidated Bottom, Subtidal, Excavated*)

The East Cape canal was constructed in the 1920's as a narrow canal crossing the marl ridge in a low area extending south to Florida Bay. The permanently flooded canal was originally excavated to assist with draining the southern Everglades region for agricultural purposes. The substrate of the excavated canal is comprised of an approximate 14-foot layer of marl underlain by approximately one foot or less of peat followed by limestone bedrock. No submerged vegetation exists within the waterway itself possibly due to strong tidal currents. The canal banks are comprised primarily of regularly flooded mangrove wetlands dominated by red mangrove, black mangrove, and white mangrove. This community has a groundcover dominated by saltwort and bushy seaside oxeye varying in density from sparse to dense. As the gradient increases northward toward the East Cape Extension canal failed dam site, the mangrove wetland transitions to an irregularly flooded community dominated by buttonwood and saltwort with a lesser component of white mangrove and black mangrove. This community is an open shrub canopy intermixed dense stands of saltwort.

Southern Interior – Embayment not opening directly into Gulf of Mexico / Mangrove Swamp (FLUCFCS – 542 / 612)

USFWS – E2SS3U (*Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Unknown Tidal*) and E2USM (*Estuarine, Intertidal, Unconsolidated Shore, Irregularly Exposed*)

The habitats on the mainland side of the marl ridge are comprised primarily of a mosaic of mangrove wetland and numerous shallow bottom subtidal areas of open water. The southern interior of Cape Sable was a continuous marsh with isolated round lakes prior to the construction of the Homestead and East Cape Extension canals which increased saltwater intrusion to the interior (Wanless, 2005). These formerly freshwater southern interior marshes are separated from the intertidal habitats of Lake Ingraham by the marl

ridge. In addition to periodic overtopping of the marl ridge, the interior marsh area receives saltwater input via the failed sheet piling dam in the Homestead and East Cape Extension Canals. Further north, the central and northern interior areas contain a mosaic of freshwater, brackish, marine, and hyper-saline flora although most of the interior is dominated by red mangrove interspersed with open water (Wanless, 2005). In addition to mangroves, common flora in the central and northern interior areas includes cordgrass (*Spartina* spp.) and sawgrass (*Cladium jamaicense*).

Florida Bay – Embayment opening directly into Gulf of Mexico (FLUCFCS – 541)

USFWS – E1UBL (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal) and E1ABL (Estuarine, Subtidal, Aquatic Bed, Subtidal)

Florida Bay is located at the southernmost tip of the Florida Peninsula between the mainland and the Florida Keys, most of which lies within the boundaries of Everglades National Park. The bay is characterized by many shallow interconnected basins, with an average depth of only three feet. It is an area where freshwater from the everglades mixes with the salty waters from the Gulf of Mexico to form an estuary with interconnected basins, grassy mud banks, seagrass flats, and mangrove islands that serve as nesting, nursery, and/or feeding grounds for a host of marine animals.

3.0 PURPOSE OF AND NEED FOR ACTION AND PROJECT OBJECTIVES

As mentioned in Section 1.0, above, the NPS has long recognized the importance of addressing impacts from the Cape Sable canals. Stopping tidal flow into the cape's interior marshes is the key to revitalizing the function of these freshwater marshes. While this landscape is naturally dynamic, slowing the rate of change on this landscape may also bring about greater resilience to the cape in the face of predicted sea level rise and the possibility of more frequent and intense hurricanes. Thus, the NPS has developed preliminary engineering design concepts for the restoration of the failed dams on the East Cape Extension and Homestead canals.

3.1 Purpose of the Project

“Purpose” is an overarching statement of what the project must do to be considered a success. The purpose of this project is to restore the failed dams on the Homestead and East Cape canals in the Cape Sable area of Everglades National Park. This project is intended to provide sustainable solutions to issues associated with saltwater intrusion into and degradation of freshwater and brackish marshes north of the marl ridge; illegal motorized boat access into the Marjory Stoneman Douglas Wilderness area; and unsafe conditions for motorized and non-motorized boaters at the dam sites.

3.2 Need for Action

“Need for Action” describes why action is required. It summarizes the most important points of the planning issues and provides the reasons the project is needed at this time. Restoration of the failed dams is needed to ...

- Control the canal-induced intrusion of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge

- Restore the existing dams, installed in the late 1950s and replaced in the 1980s and 1990s, which have failed, so they can function effectively
- Protect the freshwater and brackish interior marshes and surrounding areas, which serve as habitat for fish and wildlife
- Reduce illegal motorized boat entry into the Marjory Stoneman Douglas Wilderness Area
- Restore safe conditions at the dam sites, which are a safety hazard to motorized and non-motorized boaters

3.3 Project Objectives

Objectives are “what must be achieved to a large degree for the action to be considered a success” (*Director’s Order 12*). All alternatives selected for detailed analysis must meet project objectives to a large degree and resolve the purpose and need for action. Objectives must be grounded in the park’s enabling legislation, purpose, significance, and mission goals and be compatible with direction and guidance provided by the park’s general management plan, strategic plan, and/or other management guidance. The following are the objectives related to the restoration of the failed dams in the Cape Sable area. The objectives are grouped by subject and are based on the needs previously presented.

3.3.1 Natural Resources

- Restrict the flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through these canals, thereby restoring the natural hydrology of the area
- Reduce freshwater loss from freshwater and brackish interior marshes through the East Cape and Homestead canals
- Improve habitat for juvenile crocodiles, wading birds, forage fish and other wildlife within the freshwater and brackish marshes north of the marl ridge
- Slow the rate of marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes
- Reduce/eliminate adverse impacts to marine resources

3.3.2 Cultural Resources

- Avoid adverse impacts to the Homestead and East Cape canals, which are historic structures, through project design or mitigation measures

3.3.3 Replacement Structure Longevity

- Replacement dams or geotubes should be designed to prevent vandals from breaching a dam by trenching around or through it, or damaging the geotubes
- Replacement structures should be designed to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance

3.3.4 Visitor Use and Experience

- Provide safe passage over restored dams for canoeists/kayakers
- Resolve safety issues associated with the existing failed sheetpile structures
- Improve the wilderness visitor experience by eliminating/reducing illegal motorized boat entry into the Marjory Stoneman Douglas Wilderness Area

4.0 ALTERNATIVES CONSIDERED

Based on the preliminary analysis, internal scoping with the NPS, and the public input related to the proposed project, the following alternatives were carried forward for analysis in the EA. Alternative drawings have been provided for review at the end of this document.

4.1 East Cape Extension Canal and Homestead Canal Alternatives

Prior to finalizing the location of each of the proposed alternatives, a Digital Terrain Model (DTM) based on aerial photography was recently created in March of 2009 for each of the failed dam sites. The purpose of the DTM was to determine the topographic features for each of the proposed restoration alternatives. The DTM was developed by contouring lands above the lowest possible tidal water line for the East Cape Extension and Homestead canal dam sites to determine the most suitable location along each canal that coincides with the highest elevation points of the adjacent low relief marl ridges. Each site was over-flown obtaining new high-resolution black and white aerial photography for photogrammetric compilation by stereo plotting methods. A survey crew using Real-Time Kinematic (RTK) – Geographic Positioning System (GPS) survey equipment surveyed (on the ground) the 3-dimensional locations of specific photo-identifiable (PID's) topographic features present in the aerial photography to 3-dimensional scale and rectified the photography.

Modeling technologies were used to develop the 3-dimensional spot elevations from the water line and above on any lands present within the prescribed area for both canal dam sites. The spot elevations peppered about the prescribed site were processed to create an AutoCAD 3-D triangular irregular network (TIN), a 3-D mesh of triangular lines connecting the 3-dimensional spot elevation points. From the TIN, contours were generated which graphically display relative elevation differences land formations above the water line. Please refer to Figures 4.1 and 4.2 below for details. Due to the remoteness of the sites, these elevation differences have not yet been correlated to NAVD 88 elevation datum. NAVD 88 datum and vertical control for the site will be completed in the near future in support of future design related activities.

The results of the DTM are represented in Figures 4.1 and 4.2 below. Figure 4.1 shows the approximate location of the preferred alternative for the East Cape Extension canal with respect to these DTM (highest) elevations. Comparative elevations in the vicinity of the existing and proposed dams are comparatively small and tend more to be sloping gently away from the canal. Such elevation changes are more indicative of the placement and spreading of excavated material away from the canal excavation during the original canal construction. There appears to be minimal topographic relief which can be associated with a low lying Marl ridge paralleling the Lake Ingram shoreline in the vicinity of the existing dam.

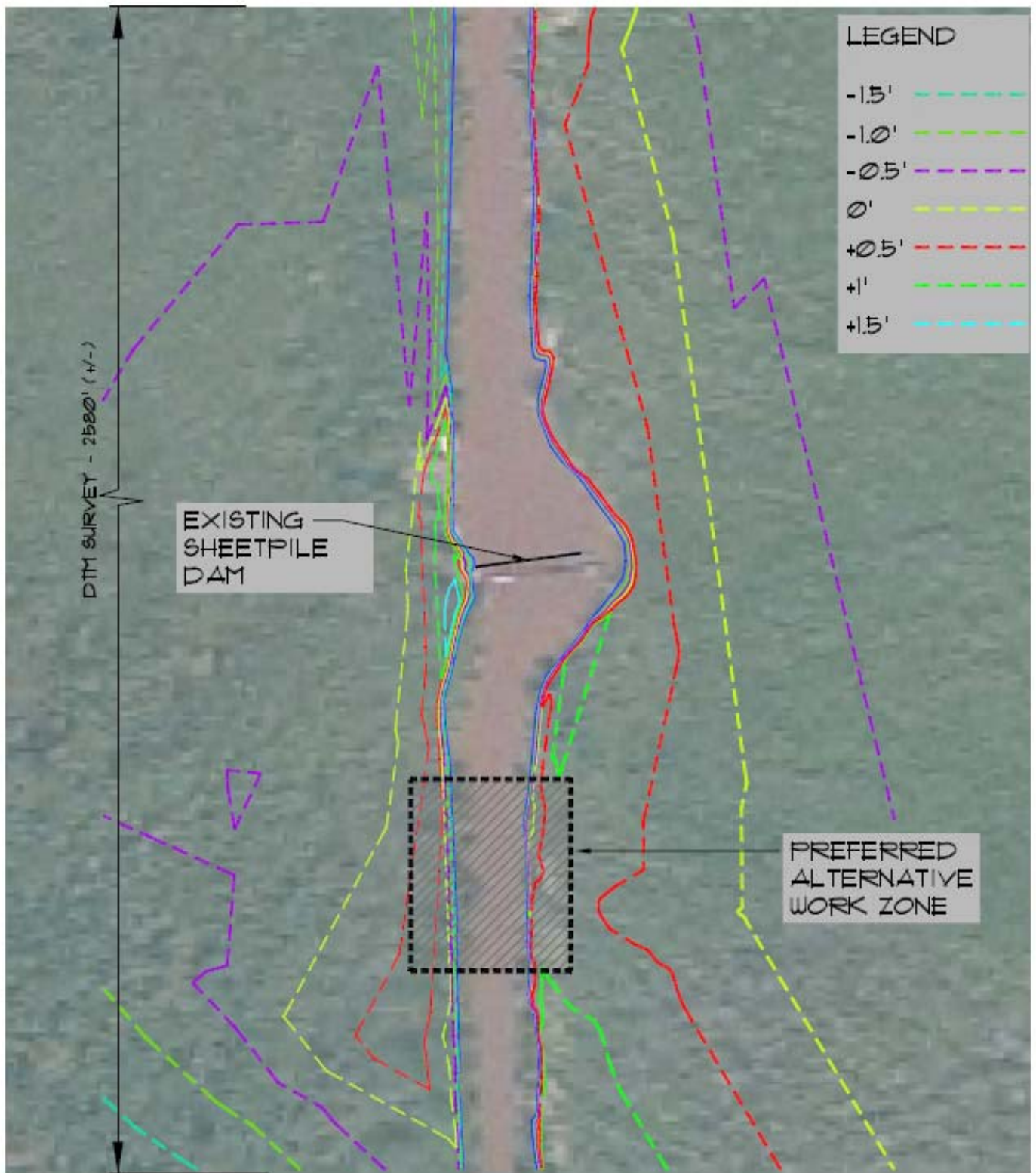
Figure 4.2 shows the approximate location of the preferred alternative for the Homestead canal with respect to these (highest) elevations. The results of the DTM survey also identified a low lying area along the Homestead Canal just south of the existing failed sheetpile structure. This low lying area is approximately 40 feet by 150 feet and would require approximately one foot of fill to mitigate the potential for short-circuiting the proposed restoration alternatives. Additional filling of the canal bank area should be performed in this area to re-establish the elevated fill berm along the edge of the canal. Such filling is recommended so that flow around and south of the proposed plug area maintains a slow overland sheetflow course and does not short circuit such overland flow by discharge into the canal. These filling activities are addressed in each of the proposed alternatives presented below, except for Alternative C, since this low lying area is located in the immediate vicinity of the failed dam and the area will be filled as part of Alternative C.

The DTM survey is available for review from the National Park Service upon request.

4.1.1 Alternative A: No Action - Continue Current Management¹

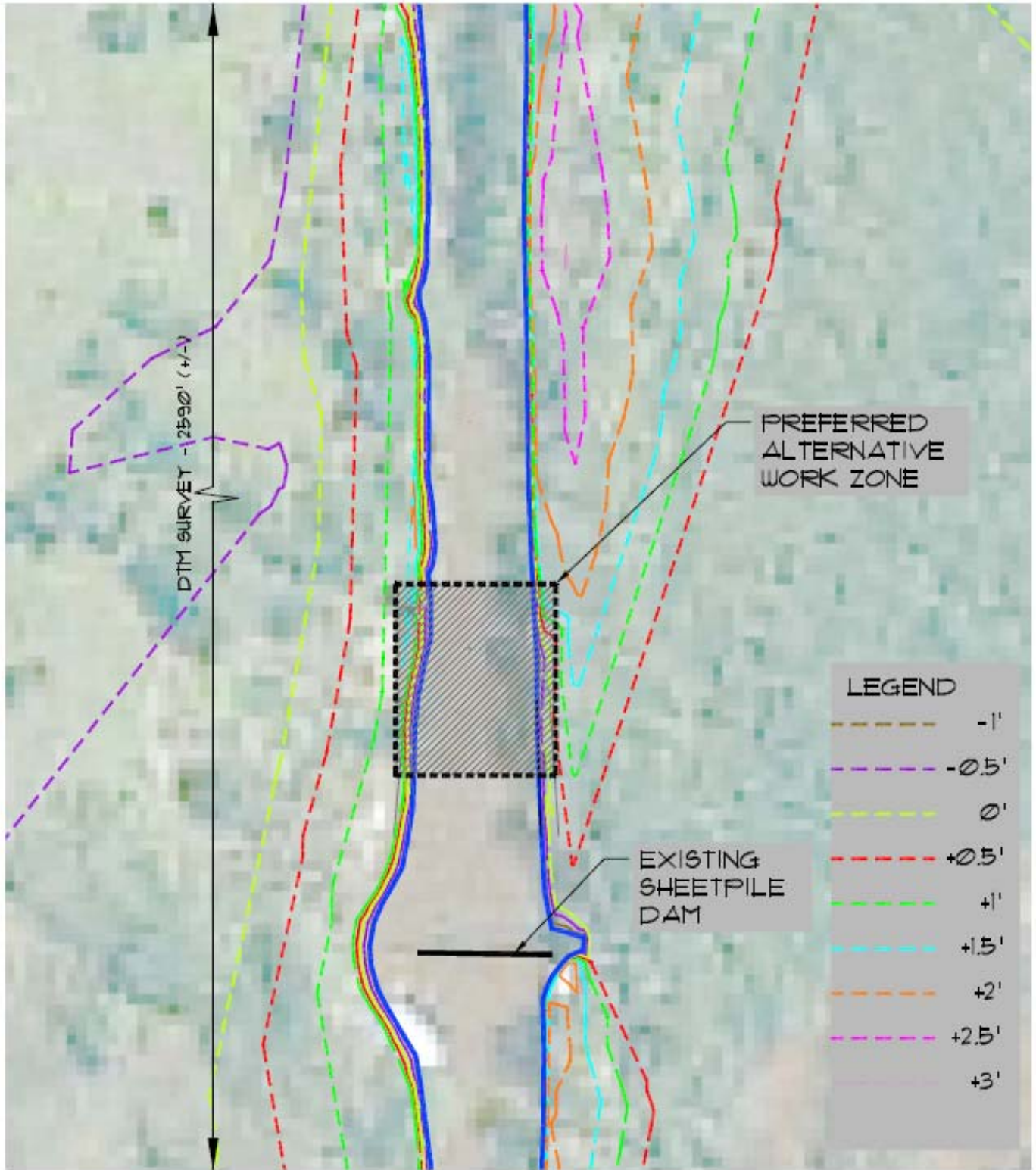
The No-Action alternative involves leaving the existing sheetpile in the East Cape Extension and Homestead canals where it is today and allowing the channel to continue to widen through natural erosional processes. This alternative would fail to accomplish the goals of the NPS and the U.S. Fish and Wildlife Service (USFWS), which are to meet the project objectives of improving fish and wildlife habitat, correct safety hazards associated with the failed structures, and preventing motorized vessel entry into Cape Sable wilderness. In addition, no action will also require NPS personnel to continue their routine inspection and maintenance program of the failed dam structures in perpetuity to prevent access to unsafe and dangerous areas. Since the failed dam structures create strong white water currents during tide changes, NPS has been using floating buoys and cables to prevent unauthorized access. Unfortunately, due to the remote location of these failed structures and the desire for people to access the interior marshes for fishing, vandalism has become an on-going maintenance issue for NPS personnel to prevent unauthorized access.

¹ Current Management includes, but is not limited to, public education about wilderness restrictions and safety hazards; maintenance of cables, floats and signs warning boaters of hazards; enforcement of regulations prohibiting motorized boats from entering wilderness area above the dams; monitoring of resource conditions and safety hazards.



SCALE OF FEET

FIG. 4.1 - LOCATION OF PREFERRED ALTERNATIVE EAST CAPE EXTENSION CANAL



SCALE OF FEET

FIG. 4.2 - LOCATION OF PREFERRED ALTERNATIVE HOMESTEAD CANAL

4.1.2 Elements Common to all Action Alternatives

Several of the elements proposed as a part of this project would be common to all the alternatives considered, excluding the no action alternative. This is due to the purpose of and needs for the project, as well as the desire to incorporate sustainable design concepts in any new construction. These elements are described below.

- Signage

To ensure safety, warning signs would be posted at each of the proposed dam structures. Signs would be constructed of reflective material and posted a minimum of 5-ft above mean high water.

- Floating Mooring Buoys

Floating mooring buoys and/or free-standing piles would also be installed downstream (towards Lake Ingraham) of the dam structures for motorized vessel anchoring. Mooring buoy anchors and/or piles would be minimized to minimize potential substrate disturbance.

- Florida Keys Staging Area

All the necessary equipment and fill (earthen fill and riprap) would be mobilized to a suitable water transportation staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) by conventional dump trucks due to a lack of a suitable staging area in Everglades National Park and to further meet the criteria for avoidance and minimization of impacts to wetland resources. The exact location of the staging area in the Florida Keys would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). Construction materials would be transported to the East Cape canal via barges and tugs to the respective construction staging/work areas. The barges are anticipated to access the East Cape canal through existing navigational channels and/or deep water areas of the Gulf of Mexico and Florida Bay originating from the designated staging area in the Florida Keys. A potential barge route is depicted in Figure 4.3. The barge route was determined using available Geographic Information System (GIS) data layers obtained from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center documenting bathymetric contours for the state of Florida and surrounding areas (NOAA CSC, 2000). The exact route would be determined by the awarded contractor; however, the route would be restricted to existing navigational channels and/or deep water areas of the Gulf of Mexico and western Florida Bay to avoid potential adverse impacts to the submerged resources.

- Woody Vegetation Clearing and Trimming

Clearing of woody vegetation would be performed where necessary, along the banks of the canal for equipment access and construction within the limits of a designated safe work zone. Trimming of overhanging mangrove trees may also need to occur within the western portion of the Homestead canal and the southern portion of the East Cape Extension canal for barge access to the designated work zone (dam site). Trimming would be conducted per the requirements of the Florida Department of Environmental Protection's (FDEP) Mangrove Trimming Permit (to be acquired prior to commencement of construction).

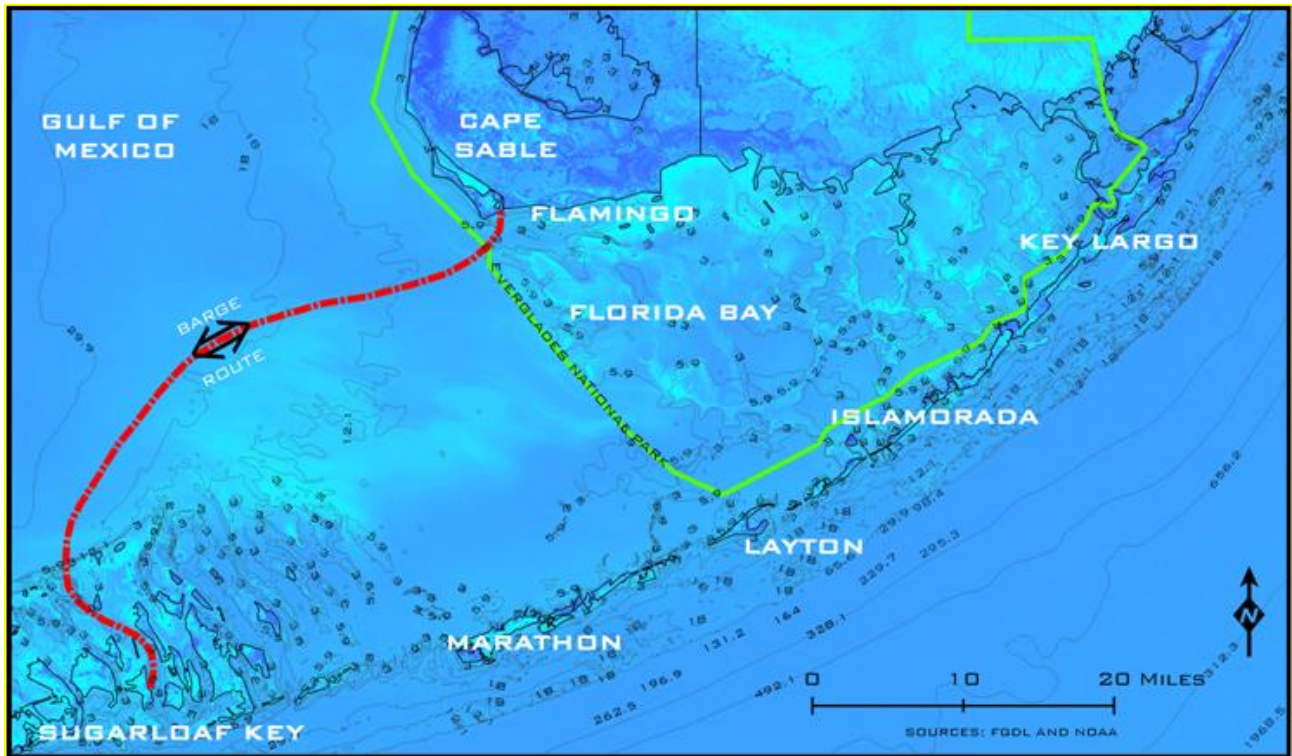


Figure 4.3 – Potential Barge Route

- Restoration of Disturbed Areas

Areas located within the designated work area that are disturbed but not permanently filled as part of the construction would be restored. The exact type of restoration would depend on the size and location of the area, but would generally include removal of any construction materials and incidental fill material, followed by regrading to the historic contours. Any non-native vegetation observed within or directly adjacent to the work area would be removed concurrent with the regrading activities. Regrading would facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area, native vegetation will be planted in the area. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of up to five years.

- Waste Management

Waste is primarily expected to be generated from servicing and maintenance of equipment. This waste is expected to be maintained on the barge. Portable toilets would be arranged and placed at the dam site. The waste from the portable toilets would be pumped out, removed from park and disposed at an appropriate disposal facility.

- Turbidity Control

Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts. A turbidity monitoring plan would be

implemented during construction to ensure continued compliance with State water quality criteria.

- Monitoring

Anticipated monitoring during construction would include water quality/turbidity monitoring and monitoring for protected wildlife species. Standard USFWS and FFWCC guidelines for the protection of protected species that have the potential to occur within the project area (including but not limited to manatees, turtles, crocodiles, and smalltooth sawfish) would be implemented during construction activities to prevent injury. Anticipated long term monitoring/maintenance would include periodical riprap monitoring/maintenance. The structural aspects of the dam would also be monitored on a quarterly basis and after each major storm event. The construction phase of the project would be conducted outside of crocodile nesting season to avoid adverse impacts to this protected species.

- Canoe/Kayak Portage

Repair of the existing breached dam would prevent illegal motorized boat entry into the wilderness area. However, the potential exists for vandals to attempt to alter the banks of the canal beyond the outer edges of the dam, enabling access for illegal motorized boats. Installation of the deflector wingwalls and/or riprap would mitigate this type of activity. Also, the repair of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters (canoeists/kayakers). To provide safe portage, a floating dock structure (less than 250 square feet) would be constructed near the center of each dam entrance. A canoe/ kayak ramp would be placed on the riprap slope adjacent to the floating dock footprint, to allow for canoes to be safely pulled out of, and placed into the water. A ramp would be placed at each end of each dam. For Alternatives D/D1 and G/G1, a hardened path would be installed across the proposed plug/dam using articulated block riprap (interlocking mats) to provide safe and sustainable passage across the plug/dam (see Alternative Drawings at the end of this SOF for portage details).

- Bank Stabilization

Banks would be stabilized within the limits of the work area to prevent internal piping and erosion of the marl into and through the riprap. This is accomplished by first placing a layer of fine sand fill over the existing sub-grade to establish a 2.5:1 side slope, which would act as both a graded filter and drainage exit for water seeping around the ends of the sheetpile and would prevent internal piping movement of the lime silts. The fine sands would be covered by a layer of non-woven geotextile fabric to prevent movement of the fine sands into the riprap. The fabric would be covered by a riprap system consisting of a coarse bedding sand/small gravel layer overlain by a coarse riprap surface cover.

4.1.3 Action Alternative C – Repair in Place

Repairing the existing steel sheetpile walls includes extending them further inland. This alternative strengthens the existing dams by adding additional sheetpile landward on both sides of the dams. The landward sheetpile would be installed to form a flow deflector wingwall to prevent seepage and tunneling through the marl. The deflector wingwalls would also help to prevent illegal motorized boat entry into the wilderness area minimizing opportunities for vandals to alter the banks beyond the edge of the sheetpile walls.

Subsequent to sheetpile installation, fill material would be placed adjacent to the sheetpile walls (2.5:1 slope from the sheetpile to the ground) to substantially increase the lateral support for the dams. Additionally, graded riprap would be placed on top of the fill material and along the deflector wingwalls to provide erosion resistance. The repair of the existing dams would also include an engineering component to provide safe passage over the restored dam for non-motorized boaters (canoeists/kayakers).

In addition to the above, Action Alternative C for the Homestead canal dam site would require dredging a 52-foot wide by approximately 8,320 feet long temporary access channel within Lake Ingraham from the western terminus of the Ingraham canal to the Homestead canal due to the shallow water depths of Lake Ingraham. Per NPS staff, the current water elevations at high tide in Lake Ingraham are up to two feet above existing substrate with portions becoming exposed at low tide due to accelerated sediment deposition. According to Wanless and Vlaswinkel (2005), portions of the lake have transitioned from an open water system to a mud flat system in recent years. The channel would be dredged to a depth of approximately six feet below the mean low water elevation. To minimize impacts caused by dredging, a mechanical (bucket) dredge would be used. While both hydraulic and mechanical dredging methods can successfully remove the accumulated sediments within the channel, mechanically dredged sediment can be placed along the sides of the channel (less impact), versus hydraulic dredging which would require an off-site dewatering area and possible treatment equipment to allow dredge water effluent to be returned back to Lake Ingraham. For mechanical dredging operations within Lake Ingraham, accumulated sediments in the channel could be removed with a conventional barge-mounted long-reach excavator (40 to 60-ft reach). The width of the base of the dredged channel would not exceed 40 feet with anticipated 3:1 side slopes for a total top cross-sectional channel width of approximately 52 feet. The dredged material (approximately 40,000 cubic yards) would be temporarily stockpiled in areas adjacent to the dredged channel or other suitable area. Some of the dredged material would disperse through natural wave energy and erosional processes. However, construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts. A turbidity monitoring plan would be implemented during construction to ensure continued compliance with State water quality criteria. Upon completion of construction, the remaining material would be pulled back into the channel via a barge and heavy equipment (e.g., clam shell, backhoe, etc.). Over time, the dredged channel would be returned to pre-construction condition via natural processes.

4.1.4 Action Alternatives D (New 100' Plug - Marl Ridge Location) and G (New 370'/430' Plug – Marl Ridge Location)

This alternative includes the extraction and relocation of the existing free-standing sheetpile walls (previous dam structures) to narrower more suitable locations that are in better alignment with the marl ridge. It is anticipated that 80% of the extracted steel sheetpile could be reused. Additionally, earthen plugs would be constructed by installing a second sheetpile wall upstream or downstream of the first wall within the canals. For Alternative D, the two sheetpile walls would be placed a distance of approximately 100 feet apart, and for Alternative G, the two sheetpile walls would be placed a distance of approximately 370 feet (for the East Cape Extension canal dam site) or 430 feet (for the Homestead canal dam site) apart. The area between the two walls would be filled and planted with wetland vegetation to reduce the potential for erosion. The fill material would

originate from an off-site location. Landward sheetpile would be installed in all four quadrants of the plugs to form flow deflector wingwalls to promote surface sheetflow away from the dam structures and thus prevent seepage and tunneling through the marl. Additionally, fill material would be placed adjacent to each sheetpile wall (2.5:1 slope from the sheetpile to the ground on the waterward side) to substantially increase the lateral support for the dams. Graded riprap would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion resistance. These alternatives would also include an engineering component to provide safe passage over the restored dams for non-motorized boaters (canoeists/kayakers).

NPS developed a digital terrain model (DTM) by contouring lands above the lowest possible tidal water line for the East Cape Extension and Homestead Canal Dam sites in order to determine the most appropriate location along each canal that coincides with the highest elevation points of the marl ridge. Each site was over-flown obtaining new high-resolution black & white aerial photography for photogrammetric compilation by stereo plotting methods. Subsequently, a Real-Time Kinematic (RTK) Geographic Positioning System (GPS) survey field crew surveyed (on the ground) the 3-dimensional locations of specific photo-identifiable (PID's) topographic features present in the aerial photography to 3-dimensional scale and rectified the photography. The field work was conducted in March, 2009. Modeling technologies were used to develop the 3-dimensional spot elevations from the water line and above on any lands present within the prescribed area for both the East Cape Extension and Homestead canal dam sites. The spot elevations peppered about the prescribed site were processed to create an AutoCAD 3-D triangular irregular network (TIN), a 3-D mesh of triangular lines connecting the 3-dimensional spot elevation points. From the TIN, contours were generated which graphically display land formations above the water line.

To restore the low lying area identified in the DTM survey, additional fill will be added along the southern bank just east of the failed dam structure to raise the elevation along the bank approximately one foot. It is estimated that approximately 500 cubic yards of fill will be required. Since an access channel will be provided, a shallow draft barge will be used to transport the fill material to the site. Once positioned at the site, a long reach excavator will be used to transport the fill from the barge to the low lying area. A small front end loader will then be used to grade the fill placed in the low lying area to match the existing adjacent topographic elevation. Since the resulting elevation would match existing adjacent grades, regrowth of wetland vegetation is expected within two years and the area is expected to return to full functionality within five years. As a precaution, a monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in this area for a period of up to five years. If after two years, sufficient coverage of desirable species is not observed, supplemental plantings may be conducted to facilitate the process.

In addition to the above, Action Alternative D or G for the Homestead canal dam site would require dredging a 52-foot wide by approximately 8,320 feet long temporary access channel as described in Alternative C.

4.1.5 Homestead Canal Modified Alternatives

Impact minimization efforts have been considered during this study to reduce impacts to the adjacent wetland/surface water systems to the maximum extent possible while maintaining safe and sound engineering and construction practices. Therefore, modified alternatives of the above described Action Alternative D (New 100' Plug – Marl Ridge Location) and Action Alternative G (New 430' Plug – Marl Ridge Location) were developed and carried forward in the EA for further analysis for the Homestead canal only. These modified alternatives provide a construction option for the Homestead canal dam site (only) that allows for further avoidance and minimization of impacts to natural resources through eliminating the need to dredge the 52-foot wide by approximately 8,320 feet long navigational channel through Lake Ingraham as described above for Alternatives D and G for dam site access.

4.1.5.1 Action Alternatives D1 (New 100' Plug - Geotubes) and G1 (New 430' Plug - Geotubes)

Dredging of an access channel in Lake Ingraham would not be required with these modified alternatives of Alternatives D and G. Geotubes would supplant the proposed sheetpile walls associated with Alternatives D and G. Geotubes are large tubular sand bags that are filled in place by pumping sand or slurry through a pipe from a barge. They are typically used to build structures such as breakwaters, shoreline protection or island creation. For these modified alternatives, fill material would be transported to the Homestead canal work area through a constructed floating pipeline. The 6 to 8 inch pipeline would be constructed using a shallow draft barge and would run from the work area to a larger barge located at a designated staging area at the western terminus of the Ingraham canal (eastern mouth of Lake Ingraham) for a distance of approximately 1.5 to 2 miles. The constructed floating pipeline would be anchored to the northern edge of the existing channel in Lake Ingraham and the eastern edge of the approach channel to the Homestead canal. The water depths within the Ingraham canal are sufficient and would not require dredging. Fill material would be transported to the staging area at the Ingraham canal and conveyed through the pipe via hydraulic pumping to the work area in order to avoid potential adverse impacts to the lake from dredging activities. In addition, the existing sheetpile dam would be cut off at a suitable level using a torch in place of extracting the sheetpile with heavy equipment as with Alternatives D and G. The sheetpile would be removed for safety. Please reference Figure 4.4 for an aerial-view schematic of the proposed pump/pipeline system.

To restore the low lying area identified in the DTM survey, additional fill will be added along the southern bank just east of the failed dam structure to raise the elevation along the bank approximately one foot. It is estimated that approximately 500 cubic yards of fill will be required. Since an access channel will not be available to allow for a shallow draft barge to enter the work area, a helicopter will be used to transport fill material to the site and place the fill material in the low lying area. Due to the difficulty in transporting heavy equipment to the work site, manual labor will be used to grade the fill to match the existing topographic elevation. Since the resulting elevation would match existing adjacent grades, regrowth of wetland vegetation is expected within two years and the area is expected to return to full functionality within five years. As a precaution, a monitoring program would be

initiated by the NPS in order to monitor the re-growth of native vegetation in this area for a period of up to five years.

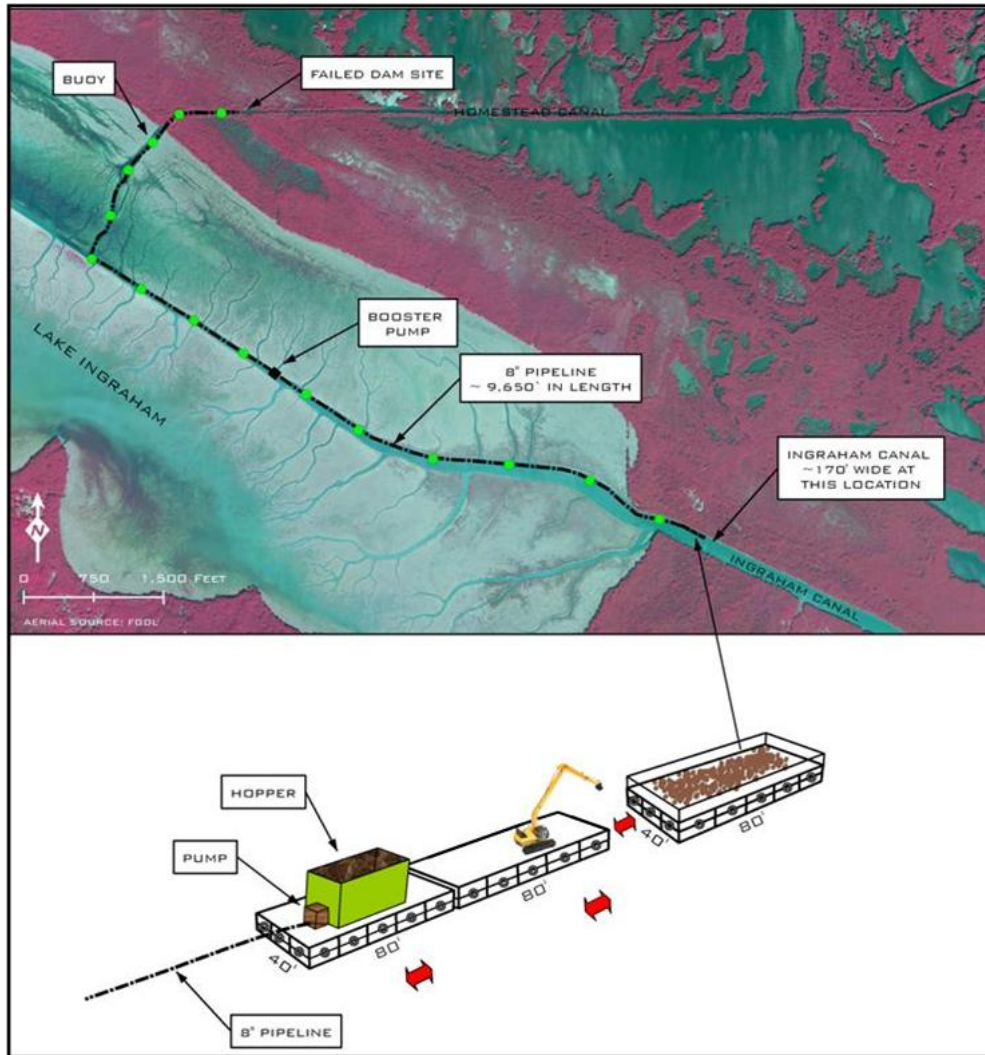


Figure 4.4 – Aerial View Schematic of Proposed Pump/Pipeline System

4.2.1 Action Alternative B - Relocate the Existing Failed Sheetpile Dams to Narrower Location

This alternative would relocate the existing failed sheetpile dams to a narrower location upstream in the canals. The relocated dams would be strengthened by adding sheetpile wingwalls landward on both sides of the dams. The wingwalls would deflect surface flows away from the dams, help prevent illegal motorized boat entry into designated wilderness and reduce opportunities for vandals to alter the banks beyond the edge of the sheetpile walls. This alternative was considered but dismissed because it is similar to retained alternative C, it would require extracting and moving the existing sheetpile to currently undisturbed areas, and because a more sustainable solution, such as a plug configuration, would be preferable.

4.2.2 Action Alternative E - Plug from Mouths of Canals Downstream to the Existing Dams

This alternative proposes plugging the two canals from their mouths upstream to the site of the existing dams to reduce tidal inflow up to the repaired dams. A sheetpile or geotube dam would be installed at the mouths of the canals which would be filled up to the existing dams or a reasonable distance beyond the highest elevation point of the marl ridge (based on the digital terrain model described in Section 4.1.4 of this document). This alternative was considered but dismissed because it is similar to retained Alternatives G and G1 and would not be optimally cited along the high topographical point at the marl ridge. Furthermore, it was deemed economically infeasible due to the increased costs of filling longer reaches of the canals.

4.2.3 Action Alternative F - Backfill East Cape Canal from Florida Bay to the Existing Dam

This alternative proposes backfilling the East Cape Canal from Florida Bay to the existing failed dam or a reasonable distance across the marl ridge at the East Cape Canal Extension. It would also consist of plugging the Homestead Canal across the width of the marl ridge. This stretch of the East Cape Canal is approximately one mile long, 250 feet wide and ten feet deep. Due to the extensive size and volume of fill required for East Cape Canal, this alternative was deemed economically infeasible and could not be implemented in a timely manner. In addition, filling the East Cape Canal from Florida Bay to the existing failed dam at the East Cape Extension Canal would cut off boat access to Lake Ingraham and the backcountry from the southern edge of Cape Sable, requiring park visitors to travel almost eight miles to the western entrance to Lake Ingraham. For these reasons, this alternative was dismissed from further consideration.

4.2.4 Action Alternative H - Backfill as Much of the Canals as is Feasible

This alternative proposes backfilling as much of the East Cape Extension and Homestead Canals as is feasible. This alternative would be very similar to two other retained alternatives, Alternatives G and G1 that include an amount of fill that was considered to be economically feasible. In addition, the East Cape Extension and Homestead Canals are both National Register-eligible historic resources and backfilling substantial portions of the canal could substantially affect the historic character of the resources. Filling the East Cape Extension and Homestead Canals would also cut off non-motorized boat access into the designated wilderness from Lake Ingraham and the East Cape Canal. This change would likely be controversial and potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

4.2.5 Action Alternative I - Plug Canals in Several Places with Geotubes or Fill

This alternative would plug the East Cape Extension and Homestead Canals in several places rather than the current configuration of only one dam at each canal. One of the objectives of the dam restoration project is 50-year sustainability of the replacement structure. This alternative would be less likely to fail than Alternatives B or C but probably would not be substantially more reliable than Alternatives D or G. Therefore, the alternative of multiple plugs in each canal was determined to be unnecessarily redundant since other alternatives put forward with only one dam location are being designed to meet the 50-year

sustainability objective. Therefore, this alternative was dismissed from further consideration.

4.2.6 Action Alternative J - Completely Fill in the Canals

This alternative proposes backfilling the entire length of the East Cape Extension and Homestead Canals. The extensive size and volume of fill required for this alternative makes it economically infeasible and it could not be implemented in a timely manner. In addition, the East Cape Extension and Homestead Canals are both National Register-eligible historic resources and backfilling substantial portions of the canal could substantially affect the historic character of the resources. Filling the East Cape Extension and Homestead Canals would also cut off non-motorized boat access into the designated wilderness from Lake Ingraham and the East Cape Canal. This change would likely be controversial and potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

4.2.7 Action Alternative K - Repairing Middle Cape Canal at Gulf of Mexico and East Cape Canal at Florida Bay

This alternative proposes repairing the Middle Cape Canal at the Gulf of Mexico and the East Cape Canal at Florida Bay. Blocking these larger canals at the coast may substantially limit spring tide incursions into the interior marshes; however, due to the extensive size and volume of fill required for this alternative, it was found to be economically infeasible and could not be implemented in a timely manner. In addition, filling of the Middle Cape Canal and East Cape Canal would entirely sever boat access to Lake Ingraham and the backcountry, prohibiting park visitors from traveling into these areas. This change would likely be controversial and potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

5.0 WETLANDS AND WETLAND FUNCTIONS

Most of Everglades National Park is prone to frequent and continual flooding due to low elevation, lack of extensive physical relief, and saline and freshwater hydrologic inputs (rainfall, overland sheet flow, tidal fluxes, and direct surface water discharges). The Cape Sable area is multifaceted, encompassing marine, estuarine and freshwater systems. Saltwater from Florida Bay and the Gulf of Mexico enters the Cape Sable region through a series of canals constructed in the early 20th century for agriculture and development purposes, as well as through natural watercourses such as Hidden and East Side creeks. Saltwater also enters the interior of Cape Sable through Whitewater Bay via Ponce De Leon Bay to the north. In addition, during moderate to high tides, the marl ridge is overtopped and substantial amounts of saltwater from the Gulf of Mexico enter the Cape Sable area.

For the East Cape Extension and Homestead canal dams, the areas to be affected by the physical footprint of the action alternatives (including the preferred alternatives) are a mixture of regularly flooded mangrove wetlands and irregularly flooded shrub-scrub buttonwood/saltwort/mangrove wetlands as well as the open water area of the canals. Figures 5.1 and 5.2 show the footprint of the preferred alternative overlain on a wetland map for the East Cape Extension canal dam site and the Homestead canal dam site,

respectively. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following the excavation of the canals in the early 20th century.



Figure 5.1 – East Cape Canal Preferred Alternative Footprint



Figure 5.2 – Homestead Canal Preferred Alternative Footprint

5.1 Special Status Species

Eleven federally listed animal species have the potential to occur in the vicinity of the project area. These species, and their status, are listed in Table 5.1, below:

Table 5.1 – Federally Listed Endangered, Threatened and Candidate Animal Species with Potential to Occur in the Cape Sable Area

Common Name	Scientific Name	Federal Status
Florida panther	<i>Felis concolor coryi</i>	Endangered
West Indian manatee	<i>Trichechus manatus</i>	Endangered
Smalltooth sawfish	<i>Pristis pectinata</i>	Endangered
Atlantic hawksbill turtle	<i>Eretmochelys imbricata</i>	Endangered
Green turtle	<i>Chelonia mydas</i>	Endangered
Kemp's Ridley turtle	<i>Lepidochelys kempii</i>	Endangered
Atlantic leatherback turtle	<i>Dermochelys coriacea</i>	Endangered
Loggerhead turtle	<i>Caretta caretta</i>	Threatened
American crocodile	<i>Crocodylus acutus</i>	Threatened
Eastern indigo snake	<i>Drymarchon corais couperi</i>	Threatened
Wood stork	<i>Mycteria Americana</i>	Endangered

Sources: NPS, IRC 2009, Glassberg 2000.

The Florida panther lives in upper dry land habitats such as hardwood hammocks, pine flatwoods, and thicket swamps near wetlands. Although it does not like extremely wet places, it would wade across waterways if necessary to find food and drier land. The USFWS developed a Standard Local Operating Procedures for Endangered Species (SLOPES) for the Florida panther (April 18, 2000). According to that SLOPES, the USFWS designated a Panther Consultation Area in south Florida that extends from Monroe and Miami-Dade Counties north to Charlotte and Glades Counties, including portions of Collier, Broward, Palm Beach, Lee and Hendry Counties. Within the designated Panther Consultation Area (PCA) are Panther Preservation Areas (PPA) ranked as Priority 1 and 2. Also included are areas otherwise designated as Conservation Lands, such as national preserves (Big Cypress), national parks (Everglades National Park), state parks (Collier-Seminole), SFWMD Water Conservations Areas (WCA-1, -2, -3), etc. The East Cape Extension canal and the Homestead canal project areas are located outside of the Panther Preservation Areas and the Panther Conservation Area. In addition, wetlands are not particularly suitable panther habitat, but only serve as refuge from loss of suitable habitat. Therefore, since it has been determined that the proposed project is not located within the PCA, and no evidence was found of panthers inhabiting the wetlands of the Cape Sable area, the proposed project is anticipated to have no effect on the Florida panther.

The West Indian manatee is typically found in coastal or estuarine waters, bays, rivers, and lakes, but may be found in inland canals during winter months. Manatees are grazers and require sheltered coves for feeding, resting, and calving. The potential for manatees exists within the East Cape Extension and Homestead canals, which are tidally connected to the waters of Florida Bay and the Gulf of Mexico. Although portions of these canals would be disturbed by all of the proposed action alternatives, the Florida Fish and Wildlife Conservation Commission's (FFWCC) standard protection measures would be utilized prior to and during all in-water construction activities to ensure that no adverse impacts to

the West Indian manatee would result. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the West Indian manatee.

The smalltooth sawfish can exist both in saltwater and freshwater, tending to prefer fairly shallow water with muddy or sandy bottoms such as rivers, streams, lakes, creeks, bays, lagoons, and estuaries. The potential exists for the smalltooth sawfish to occur within the project area and construction activities could affect the sawfish's behavior, causing them to avoid the affected area. However, these impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the smalltooth sawfish within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Furthermore, care would be taken to ensure that no smalltooth sawfish are harmed during project construction activities. Also, smalltooth sawfish protection measures established by the FFWCC would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the smalltooth sawfish.

The Atlantic hawksbill turtle inhabits coastal reefs, bays, rocky areas, estuaries, and lagoons and are generally found at depths of 70 feet or less. Hatchlings may be found in the open sea floating on masses of marine plants. Juveniles, subadults, and adults typically forage on coral reefs, although hawksbills may also occupy other hard-bottom communities and occasionally mangrove-fringed bays. This species comes to land to nest and prefers undisturbed, deep sand beaches. No suitable nesting habitat exists within the project limits (NOAA Fisheries 2007a). Construction activities could affect the hawksbill sea turtles' behavior, causing them to avoid the affected area. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the hawksbill sea turtle within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Also, sea turtle protection measures established by the FFWCC would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the Atlantic hawksbill turtle.

The green turtle is dependent upon three basic habitat types: high energy beaches for nesting; convergence zones in pelagic (open sea) habitats as juveniles, and benthic feeding grounds (namely seagrass meadows) as subadults and adults. Green sea turtle foraging areas in the southeastern United States include shallow coastal and estuarine waters with an abundance of macroalgae or seagrass. This species also occurs in non-vegetated areas near mainland coastlines, islands, reefs, or shelves, and has been observed in open-ocean surface waters, especially where wind and currents concentrate pelagic organisms (NMFS and USFWS 1991a) (NOAA Fisheries 2007a). Construction activities could affect the green sea turtles' behavior, causing them to avoid the affected area. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the green sea turtle within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Also, sea turtle protection measures established by the FFWCC would be employed during all in-

water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the green turtle.

The Kemp's Ridley turtle inhabit shallow coastal and estuarine waters over sand or mud bottoms. Juveniles feed on sargassum, while adults are largely shallow-water benthic feeders whose food items include shrimp, snails, bivalves, jellyfish, and marine plants (NOAA Fisheries 2007a). Adults are restricted to the Gulf of Mexico; however, the pelagic juveniles also occur in the Atlantic Ocean (presumably dispersed by major oceanic currents). Kemp's Ridley sea turtles might temporarily forage in the open water areas in the vicinity of the proposed project; however, no suitable nesting habitat exists within the project limits. Construction activities could affect the Kemp's Ridley sea turtles' behavior, causing them to avoid the affected area. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the Kemp's Ridley sea turtle within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Also, sea turtle protection measures established by the FFWCC would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the Kemp's Ridley turtle.

Atlantic leatherback sea turtles spend most of their time in the open sea, entering coastal waters only when nesting and/or in pursuit of jellyfish aggregations. Critical habitat for the leatherback includes a strip of land at, and the waters adjacent to, Sandy Point on the western end of St. Croix, U.S. Virgin Islands (NOAA Fisheries 2007a). Nesting occurs from February to July with sites located from Georgia to the U.S. Virgin Islands. During the summer, leatherbacks tend to be found along the east coast of the United States from the Gulf of Maine south to the central coast of Florida (NOAA Fisheries 2007a). Leatherbacks might temporarily forage in the open water areas in the vicinity of the proposed project; however, no suitable nesting habitat exists within the project limits. Construction activities could affect the leatherback sea turtles' behavior, causing them to avoid the affected area. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the leatherback sea turtle within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Also, sea turtle protection measures established by the FFWCC would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the Atlantic leatherback turtle.

Loggerhead turtles typically occur over the continental shelf and in bays, estuaries, lagoons, creeks, and mouths of rivers, but have been found as far as 500 miles offshore (NMFS and USFWS 1991b). Nesting primarily occurs on barrier islands adjacent to continental landmasses in warm-temperate and sub-tropical waters (NMFS and USFWS 1991b). In the continental United States, loggerheads nest along the Atlantic coast and sporadically along the Gulf coast (NMFS and USFWS, 1991b). Nest sites are typically located on high-energy, open sandy beaches above the mean high tide and seaward of well-developed dunes; however, no suitable nesting habitat exists within the project limits. After hatching, juvenile loggerheads move directly to sea and often float in masses of

sargassum (NMFS and USFWS, 1991b) (NOAA Fisheries 2007b). Construction activities could affect the loggerhead sea turtles' behavior, causing them to avoid the affected area. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the loggerhead sea turtle within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Also, sea turtle protection measures established by the FFWCC would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, the proposed project may affect but is not likely to adversely affect the loggerhead turtle.

The American crocodile is distributed along a broad range of coastal and estuarine shores in parts of Mexico, Central and South America, the Caribbean, and the extreme tip of southern Florida (Gaby et al. 1985; Kushlan and Mazzotti 1989a; Kushlan and Mazzotti 1989b; Van Meter 1992; Hamilton 1999; Mazzotti 1999; Mazzotti and Cherkiss 2003). Historically in Florida, the American crocodile ranged from Lake Worth on the east coast, south through the upper keys and west through Florida Bay, and north to Charlotte Harbor (Kushlan and Mazzotti 1989a; Van Meter 1992). The recent distribution of the American crocodile in Florida is much more restricted, with documented populations across the southern tip of Florida from Cape Sable to southern Biscayne Bay, including Key Largo (Kushlan and Mazzotti 1989a; Hamilton 1999). American crocodile habitat in Florida Bay is defined as mangrove lined ponds, creeks, and shorelines, and man-made ponds and canals associated with them (Kushlan and Mazzotti 1989b; Van Meter 1992). American crocodile nesting habitat consists of mounds and holes built and dug in elevated substrate along the coast (Kushlan and Mazzotti 1989b; Van Meter 1992; Mazzotti and Cherkiss 2003). American crocodile nesting in Florida Bay occurs between the months of March and September (Kushlan and Mazzotti 1989b). Nesting and hatchling success has been linked to several factors, including salinity, fertility, predation, temperature extremes, moisture conditions, erosion of nest sites, and human disturbance (Mazzotti 1989). The American crocodile was designated as endangered on 25 September 1975 under the Federal Endangered Species Act (Federal Register 40:44149) (Van Meter 1992; Hamilton 1999; Mazzotti 1999; Mazzotti and Cherkiss 2003). Critical habitat for the American crocodile was designated in December of 1979 (Federal Register 45:10350-10355) (Hamilton 1999; Mazzotti and Cherkiss 2003). The federal status of the American crocodile was downlisted from Endangered to Threatened in May 2008 due to a recovery of the population, a large portion of which is located in the Cape Sable area. Seventy-five nests were located along the banks of the East Cape Extension and Homestead canals in 2007 and 2008 combined (M. Parry, NPS, personal communication, 2008). Construction activities for the proposed project would be limited to the months of October through February, during which no American crocodile nesting occurs. Therefore, due to the limiting timeframe of nesting activities and construction, the proposed project may affect but is not likely to adversely affect the American crocodile.

The Eastern indigo snake is found in a variety of habitats and would readily utilize disturbed areas and populated residential areas; however, their preferred habitat is dry pineland bordered by water. The project area consists of large expanses of wetland, which are not particularly attractive as habitat to this snake. Because the project location lacks the preferred snake habitat, there is a relatively low potential for this project to impact the Eastern indigo snake. In addition, project construction may be temporarily disruptive to

individual snakes; therefore, it is predicted that any individual snake would migrate away from the construction work zone during construction activities. Also, Eastern indigo snake protection measures established by the USFWS would be employed during all construction activities. Therefore, based on the minimal potential for this snake to be present, and the implementation of these protection measures, it has been determined that this project may affect, but is not likely to adversely affect the Eastern indigo snake.

The wood stork is usually found nesting colonially in a variety of inundated forested wetlands, mixed hardwood swamps, sloughs, and mangroves. The wood stork forages mainly in shallow water in freshwater marshes, swamps, lagoons, ponds, tidal creeks, flooded pastures and ditches, where they are attracted to falling water levels that concentrate food sources (mainly fish). USFWS database records (USFWS 2009) indicate the existence of one active nesting colony located near the project area. This colony is located approximately 14.2 miles northeast of the project corridor. Therefore, the project is located in the CFA (within 18.6 miles) of this nesting colony. To minimize adverse effects to the wood stork due to any loss of wetlands, the USFWS recommends that any lost foraging habitat resulting from the project be replaced within the CFA of the affected nesting colony. However, based on the wetland functional benefits derived from the proposed project versus the minor impacts to wetlands and the fact that no suitable foraging habitat for the wood stork exists within the project limits, it has been determined that this project may affect, but is not likely to adversely affect the wood stork.

5.2 Wetland Impacts, Functional Assessment and Mitigation Analysis

Alternative A (No-Action)

1) Analysis. Under Alternative A, no construction would take place and current conditions/processes would continue. There would be no direct adverse effect from construction on existing wetland vegetation communities within the project area.

However, taking no action to address the issues associated with the failed sheetpile dams on the East Cape Extension and Homestead canals would sustain the anthropomorphic impacts on erosional processes within these canals and the greater Cape Sable area. As mentioned earlier, according to Wanless and Vlaswinkel (2005), the collapse of the southern interior marsh is a direct result of the lowering of the marsh with construction of the canals through the marl ridge, as well as large storm events/hurricanes and saline intrusion. The areas of open water have continued to gradually expand northward and the areas colonized by mangroves have progressed. Peat soil is lost and freshwater marsh communities are being replaced by open water saline communities. Thus, the characteristics and functions of large portions of the interior marsh wetlands are transitioning at increased rates from brackish ecosystems to marine ecosystems adversely impacting existing wildlife utilizing these areas (see the Wildlife and Wildlife Habitat section of this EA for further details). This process is accelerated with the substantial amount of saltwater moving through the Homestead and East Cape Extension canals where the dams have failed. These processes would continue to act at current or potentially increasing rates. Related erosion and channel widening could also be expected to continue resulting in long-term degradation and permanent loss of portions of adjacent and downstream vegetated wetlands. Therefore, with Alternative A, long-term moderate to major adverse impacts to existing wetland resources could be expected.

Long-term, indirect, negligible to minor adverse impacts to the wetland areas directly adjacent to the existing dams are also anticipated to continue to occur as a result of canoe/kayak portage around the failed dam sites due to the dangerous conditions (i.e., strong currents, eddies, etc.) of trying to paddle through the waterway past the failed dam sites. This off-trail use by visitors has the potential to trample and possibly eliminate desirable wetland vegetation through continual usage of the trail. This impact, although minor, has the potential to introduce opportunities for the growth of nuisance, opportunistic and/or exotic vegetation within areas of higher elevation (i.e., areas with minimal/infrequent inundation allowing for the growth of exotic species). Furthermore, without the existence of a deterrent from entering the wilderness area or upstream marshes of Cape Sable, use of this area by motorized boats is likely to continue further degrading these interior marshes through disturbance and pollution from fuels, greases and oils.

While all the environmental impacts of climate change would affect South Florida and Everglades National Park within the next century, the key concern for the lowlying Cape Sable area would be rising sea level, “with a very high likelihood” that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF, 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior freshwater and brackish marshes of Cape Sable.

2) Cumulative Impacts. No cumulative impacts to vegetation and wetlands would occur as a result of combining the cumulative projects with the actions contained in Alternative A because the effects of the cumulative projects would be negligible. Impacts to vegetation and wetlands would be limited only to those direct and indirect impacts resulting from Alternative A. For more information on the cumulative projects and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3 of the EA document, respectively.

3) Conclusion. No direct impacts to wetland/surface water areas would result with Alternative A. There would be moderate to major adverse effects to the wetland systems of the greater Cape Sable area. There would also be long-term, negligible to minor adverse impacts resulting from ongoing visitor use in and around the existing dam sites. No beneficial effects to wetlands are anticipated as a result of Alternative A. Alternative A would produce moderate to major adverse impacts on wetlands. Consequently, there would be no impairment of wetlands as a result of Alternative A.

Action Alternative C (Repair in Place)

1) Analysis. Under Alternative C, the existing dam sites would be repaired along the East Cape Extension and Homestead canals. Wetland and surface water impacts would be largely restricted to the immediate banks of the canal. Impact minimization efforts have been considered during this study to reduce impacts to the adjacent wetland/surface water systems to the maximum extent possible while maintaining safe and sound engineering and construction practices. Unavoidable wetland impacts would occur since the project is wetland dependent and constructed entirely within wetlands/surface waters. Unavoidable direct impacts (permanent and temporary) were quantified for Alternative C based on the aerial extent of wetlands/surface waters within the proposed construction limits. The resulting quantities are depicted in Table 5.2, below:

Table 5.2 – Direct Impacts to Wetlands/Surface Waters for Alternative C

Wetland/Surface Water ID ²	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft ²)	Direct Wetland Impacts (acres)
<i>E1UBLx</i>	Fill and Riprap - Permanent	East Cape Extension Canal	2,732.54	0.063
<i>E1UBLx</i>	New Sheetpile - Permanent	East Cape Extension Canal	67.77	0.001
<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of East Cape Extension Canal	3,522.52	0.081
<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of East Cape Extension Canal	499.82	0.011
<i>E2SS3P/E2EMP</i>	Temp. Work Zone Clearing - Temporary	Banks of East Cape Extension Canal	6,652.73	0.153
<i>E1UBLx</i>	Fill and Riprap - Permanent	Homestead Canal	2,848.15	0.065
<i>E1UBLx</i>	New Sheetpile - Permanent	Homestead Canal	122.05	0.003
<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of Homestead Canal	4,112.58	0.095
<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of Homestead Canal	469.66	0.011
<i>E2SS3P/E2EMP</i>	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	7,917.63	0.182
<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of Homestead Canal	38,798.32	0.891
<i>E2USM/N</i>	Access Dredging - Temporary	Substrate of Lake Ingraham	1,431,040.00	32.852

Direct permanent impacts of 0.064 acres and 0.068 acres within surface waters of the East Cape Extension and Homestead canals, respectively, would occur as result of implementing Alternative C. These filling impacts are a direct result of the placement of the additional sheetpile needed to extend the existing dam to the banks of the canal as well as the placement of earthen fill and riprap for stabilization and armoring. Direct permanent impacts of 0.092 and 0.106 acres within wetlands along the banks of the East Cape Extension and Homestead canals, respectively, would also occur. These filling impacts are associated with the placement of the additional sheetpile needed for the wingwalls as well as the placement of riprap for support and armoring. In addition to the above, less than 0.006 acres (250 square feet) of permanent shading impacts to both the East Cape Extension and Homestead canals would occur as a result of the proposed non-motorized boat (canoe/kayak) portage system. However, since no submerged aquatic vegetation are known to exist within these waterways, this new shading impact is negligible. Also, floating mooring buoys and/or free-standing piles would be installed downstream (towards Lake

² Wetland/Surface Water identification codes define the type and characteristics of the wetland/surface water area. These codes are defined in detail in Section 2.0 of this document.

Ingraham) of the dam structure for motorized vessel anchoring. Mooring buoy anchors and/or piles would minimize potential substrate disturbance. As a result, the moorings would minimize potential secondary impacts to the canal bottom from the use of standard boat anchors. As stated above, since no submerged aquatic vegetation are known to exist within these waterways, the impacts associated with installation of the moorings are negligible.

To minimize wetland resource impacts, BMPs would be implemented during construction. These practices would include employment of staked silt fence and turbidity barriers. Silt fence would be employed prior to commencement of construction around the outer perimeter of each work zone to minimize the potential for impacts to adjacent undisturbed wetlands. Turbidity barriers would be employed in the canals prior to commencement of construction at a sufficient distance (approximately 500 feet if conditions allow) from the work zone to create a temporary mixing zone upstream and downstream of the dam location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs (see Water Resources section of EA for details on OFWs), which has restrictive requirements pertaining to water quality (i.e., restricted to zero NTUs above ambient). The barriers would remain in place and be regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted, etc.) and possibly replanted with native coastal wetland vegetation if regrowth does not occur naturally. The turbidity barriers and silt fence would be removed at the work areas in the canals once turbidity has subsided following construction completion of the dams.

Due to the space limitations in the work area, designated work zones have been established along the canal banks in which equipment would be staged for use during construction. Additional staging is anticipated to occur on floating barge(s) along the East Cape canal at the approximate location where the Ingraham canal branches off to the west and along the Homestead canal just west of the work zone. The barge(s) are anticipated to access the East Cape Extension canal through existing navigational channels and/or deep water areas of Florida Bay, and Lake Ingraham and the Homestead canal through the Ingraham canal, Lower East Cape canal, and existing navigational channels and/or deep water areas of western Florida Bay. The barge(s) would originate from a designated staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) due to a lack of a suitable staging area in Everglades National Park and to further meet the criteria for avoidance and minimization of impacts to wetland resources (see Figure 4.3 for the potential barge route). The exact location of the staging area in the Florida Keys would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). No adverse impacts to protected wetland resources are anticipated to occur as a result of utilizing the proposed accessways.

For the Homestead canal (only), barge(s) are anticipated to access the work zone with the dredging of a 52-foot wide by approximately 8,320 feet long temporary access channel

through the shallow water depths within Lake Ingraham. Per NPS staff, the current water elevations at high tide in Lake Ingraham are up to 2 feet above existing substrate with portions becoming exposed at low tide due to accelerated sediment deposition. Portions of the lake have transitioned from an open water system to a mud flat system in recent years (Wanless and Vlaswinkel, 2005). The channel would be dredged to a depth of approximately six feet below the mean low water elevation. To minimize impacts caused by dredging, a mechanical (bucket) dredge would be used. While both hydraulic and mechanical dredging methods can successfully remove the accumulated sediments within the channel, mechanically dredged sediment can be placed along the sides of the channel (less impact), versus hydraulic dredging which would require an off-site dewatering area and possible treatment equipment to allow dredge water effluent to be returned back to Lake Ingraham, which has the potential to result in moderate to major adverse impacts to the water quality of Lake Ingraham. For mechanical dredging operations within Lake Ingraham, accumulated sediments in the channel could be removed with a conventional barge-mounted long-reach excavator (40 to 60-ft reach). The width of the base of the dredged channel would not exceed 40 feet with anticipated 3:1 side slopes for a total top cross sectional channel width of approximately 52 feet. The dredged material (approximately 40,000 cubic yards) would be temporarily stockpiled in areas adjacent to the dredged channel outward to a maximum distance of approximately 60 feet on both sides [for a total temporary impact footprint of approximately 172 feet wide by 8,320 feet long (32.852 acres)]. Turbidity resulting from the dredging operation would be contained within the construction footprint using staked and/or floating turbidity curtains or other suitable barriers to minimize the potential for turbidity beyond the limits of construction. The barriers would be employed prior to commencement of construction activities and remain in place and regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFW (see Water Resources section of EA for details on OFWs), a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). Upon completion of construction at the Homestead canal dam site, the dredged material in Lake Ingraham would be pulled back into the channel via mechanical means and the turbidity barriers would be removed once turbidity has subsided. Some of the dredged material would disperse beyond the turbidity barriers via tidal currents and wave energy; however, due to the lack of submerged aquatic vegetation in Lake Ingraham, the effect would be considered minor to negligible. The channel would be returned to pre-construction condition upon completion of construction. Per discussions with the regulatory agencies, since no protected submerged aquatic vegetation exists in the area to be dredged, the backfilling of the channel would serve as mitigation for dredging impacts to Lake Ingraham. Additionally, any resulting temporal functional losses due to this temporary impact would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior marshes of Cape Sable (see below for details).

In addition to dredging, trimming of overhanging mangrove trees may need to occur within the canals for barge access. Trimming would be conducted per the requirements of the FDEP's Mangrove Trimming Permit (to be acquired prior to commencement of construction). Approximately 0.415 acres (18,081.08 s.f.) along the East Cape Extension

canal and 0.891 acres (38,798.32 s.f.) along the Homestead canal may require trimming (areas based on aerial coverage of vegetation over each waterway between the mouth of each canal at Lake Ingraham and the existing dam site that would need to be trimmed to allow for barge access). Following construction completion, regrowth of the mangroves over the waterway would be left unrestricted and the area is expected to return to full functionality within five years.

The 0.153-acre temporary work zone along the East Cape Extension canal and the 0.182-acre temporary work zone along the Homestead canal would be temporarily cleared of woody vegetation above the existing substrate prior to construction. Following completion of construction activities, the work zone would be restored (e.g., regraded, compacted, etc.) to pre-existing conditions to facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area, native vegetation will be planted in the area. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of up to five years.

The areas to be affected by the physical footprint of the alternative are a mixture of regularly flooded mangrove wetlands and irregularly flooded shrub-scrub buttonwood/saltwort/mangrove wetlands as well as the open water area of the canal. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the canals.

Per Chapter 62-345 Florida Administrative Code (F.A.C.), a functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using the Florida Department of Environmental Protection's (FDEP) Uniform Wetland Mitigation Assessment Method (UMAM) (FDEP, 2004) which has been adopted by the South Florida Water Management District (SFWMD) on February 2, 2004 and, as of August 1, 2005, has also been adopted by the U.S. Army Corps of Engineers (USACE). The UMAM provides a standardized procedure for assessing the functions provided by wetlands and other surface waters; the amount that those functions are reduced by a proposed impact; and the amount of mitigation necessary to compensate for that loss in terms of current condition; hydrologic connection; uniqueness; location; fish and wildlife utilization; time lag; and mitigation risk. Impacts to surface water areas with no protected submerged aquatic vegetation typically do not require mitigation; thus, a UMAM analysis was not performed for impacts to the waterway itself. A summary of the results of the assessment on the area to be permanently and temporarily impacted is provided in Table 5.3 below. In Table 5.3, "Current" indicates the functional value of the assessment area based on existing conditions per the three categories of indicators of wetland function (location and landscape support, water environment and community structure) scored to the extent that they affect the ecological value of the assessment area. Scores per each category range from ten to zero based on reasonable scientific judgment. A score of ten indicates an optimal level whereas a score of zero indicates a severely diminished or negligible level. The "Current" score is determined by summing the scores for each of the indicators and dividing that value by 30 to yield a number between zero and one. The "Current" assessment score is calculated twice, providing a functional assessment score without

construction (existing conditions) and a functional assessment score with construction (proposed conditions). The “Delta” indicates the functional value difference between the existing conditions (without construction) and the proposed conditions (with construction). For example, a negative delta would indicate that a loss in functional value would occur with construction. “Functional Loss” indicates the total calculated loss based on the size of the wetland being impacted and the loss in functional value that would occur (impact area x “Delta”). For further details of the functional assessments, the UMAM assessment forms have been provided at the end of this Wetland SOF for review.

Table 5.3 – UMAM Functional Assessment – Impacted Areas - Alternative C

	Impact Area ID	Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
East Cape Extension Canal	Canal Banks – Filling	Perm	0.092 acres	0.667	0.500	-0.167	-0.015
	Canal Banks – Mangrove Trimming	Temp	0.415 acres	0.667	0.600	-0.067	-0.028
	Canal Banks – Work Zone Clearing	Temp	0.153 acres	0.700	0.533	-0.167	-0.026
Homestead Canal	Canal Banks – Filling	Perm	0.106 acres	0.667	0.500	-0.167	-0.018
	Canal Banks – Mangrove Trimming	Temp	0.891 acres	0.667	0.600	-0.067	-0.059
	Canal Banks – Work Zone Clearing	Temp	0.182 acres	0.700	0.533	-0.167	-0.030
	Lake Ingraham - Access Channel Dredging	Temp	32.852 acres	0.667	0.433	-0.233	-8.761

The UMAM analysis indicates that the banks of the East Cape Extension and Homestead canals have an existing functional assessment score ranging from 0.667 to 0.700, which falls within the moderate quality range, between 0.50 and 0.79. Wetlands assigned UMAM scores less than 0.50 are typically highly disturbed and have limited wetland functions. Wetlands assigned UMAM scores greater than 0.79 are typically high quality wetlands with pristine wetland functions.

As shown in Table 5.3, the functional loss for 0.092 acres and 0.106 acres of permanent filling impacts to wetlands along the East Cape Extension and Homestead canals was determined to be -0.015 and -0.018, respectively; the functional loss for 0.415 acres and 0.891 acres of temporary impacts to mangroves as a result of trimming activities along the East Cape Extension and Homestead canals was determined to be -0.028 and -0.059, respectively; the functional loss for 0.153 acres and 0.182 acres of temporary impacts to

wetlands as a result of vegetation clearing activities along the East Cape Extension and Homestead canals was determined to be -0.026 and -0.030, respectively; and the functional loss for 32.852 acres of temporary impacts to Lake Ingraham as a result of dredging a temporary access channel was determined to be -8.761. Thus, the total functional loss for 0.092 acres of permanent impacts and 0.568 acres of temporary impacts to wetlands with implementing Alternative C for the East Cape Extension canal is -0.069. In addition, the total functional loss for 0.106 acres of permanent impacts and 33.925 acres of temporary impacts to wetlands with implementing Alternative C for the Homestead canal is -8.868.

All BMPs typically associated with NPS construction projects would be properly implemented and maintained throughout all construction activities minimizing short-term secondary impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing zone upstream and downstream of the dam location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting, etc.) and placement of riprap on disturbed banks for stability.

The potential for long-term secondary impacts resulting from the project were also analyzed due to the lack of a vegetative buffer between the proposed dam sites and the adjacent wetlands. However, since the area is located in the backcountry of Everglades National Park and no active roadways or trails lead to this area, continued long-term disturbance at the dam sites is not anticipated. In addition, the potential for long-term, indirect, negligible to minor adverse impacts to the wetland areas directly adjacent to the existing dams would be remedied through the construction of canoe/kayak portages over the new dams. Details of the portage are discussed in Section 4.0 of this document. Thus, this observed activity is not anticipated to continue following dam construction, which provides a net benefit in relation to indirect/secondary impacts.

Furthermore, no adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be permanently impacted with construction of this alternative, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior marshes of Cape Sable (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of Alternative C (see above). This is evidenced through the use of the UMAM functional analysis, which was used to assess the potential benefits to the interior marsh and Lake Ingraham (see Figure 5.3 for locations of the proposed offsite mitigation

areas) derived as a result of the proposed project. Since the Cape Sable area interior marsh wetlands are contiguous and retain similar wetland functions, it was appropriate to conduct one UMAM functional assessment for the entire area. In addition, the temporary impacts would be mitigated through onsite restoration activities as discussed above; however, a mitigation UMAM functional analysis was also performed for these temporary impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior marshes of Cape Sable. The resulting UMAM assessment scores are provided in Table 5.4, below. Copies of the UMAM scores for the mitigation areas have been enclosed for review at the end of this SOF.

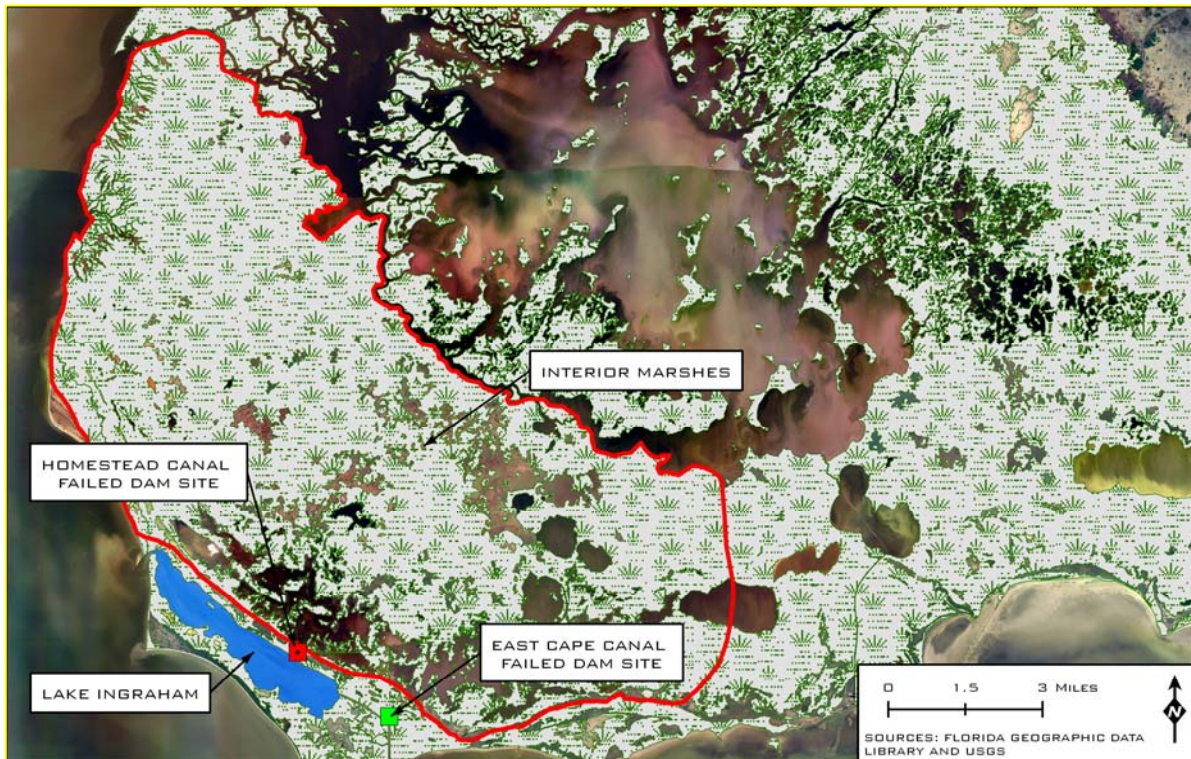


Figure 5.3 – Offsite Wetland Mitigation Areas

Table 5.4 – UMAM Functional Assessment for Mitigation Areas – Alternative C

Mitigation Area ID		Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
East Cape Extension Canal	Mangrove Trimming Onsite Restoration	0.415 acres	0.600	0.667	0.067	1.14	1.25	0.047	0.019
	Temporary Work Zone Onsite Restoration	0.153 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.018
Lake Ingraham Offsite Enhancement		1,863 acres	0.700	0.767	0.100	1.0	1.25	0.080	149.040
Interior Marshes Offsite Enhancement		55,894 acres	0.667	0.767	0.067	1.0	1.25	0.053	2,962.382
Homestead Canal	Mangrove Trimming Onsite Restoration	0.891 acres	0.600	0.667	0.067	1.14	1.25	.047	0.042
	Temporary Work Zone Onsite Restoration	0.182 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.021
	Access Channel Dredging Onsite Restoration	32.852 acres	0.433	0.667	0.233	1.03	1.25	0.181	5.946

The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation site) and risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) scores for the mitigation areas listed in Table 3.3, above, were determined as follows:

Mangrove Trimming Restoration (East Cape Extension and Homestead canals): The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for regrowth of trimmed mangroves and attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

Temporary Work Zone Restoration (East Cape Extension and Homestead canals): The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for regrowth of the mangrove/saltwort-dominated vegetation and attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

Access Channel Restoration (Lake Ingraham - Homestead canal): The time lag was determined to be two years resulting in a T-factor score of 1.03 to attain comparable pre-impact conditions as a regularly to periodically exposed mud flat with algal and cyanobacterial mats on the substrate. The risk was determined to have a score of 1.25 since vulnerability is low with high probability of success.

Lake Ingraham and the Interior Marshes: The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation sites) was determined to be immediate (less than one year) resulting in a T-factor score of 1.0 due to the following immediately derived benefits:

- Lake Ingraham
 - The dams would slow the rate of sediment deposition in Lake Ingraham as a result of marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes
 - The dams would improve habitat for wading birds, forage and game fish and other wildlife within Lake Ingraham due to the decrease in sediment deposition rates
- Interior Marshes
 - The dams would restrict the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through these canals
 - The dams would reduce freshwater loss from freshwater and brackish interior marshes through the East Cape Extension and Homestead canals
 - The dams would slow the rate of marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes
 - The dams would improve nesting and juvenile habitat for crocodiles, wading birds, forage and game fish and other wildlife within the freshwater and brackish marshes north of the marl ridge

The risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) was determined to have a score of 1.25. The risk factor was determined based on the potential for scour during high tidal fluxes overtopping the marl ridge to erode new channels around the permanent riprap armor.

The mitigation functional gain was calculated as follows:

- A relative functional gain [$\text{mitigation Delta} / (\text{risk} \times \text{time lag})$] of 0.019 and 0.042 for mangrove trimming onsite restoration for the East Cape Extension and Homestead canals, respectively. The actual mitigation functional gain (gain in functions

provided by that mitigation assessment area = mitigation acres x relative functional gain) provided by this onsite restoration (allowing for unrestricted regrowth of mangroves over the waterway) is 0.008 and 0.037 for the East Cape Extension and Homestead canals, respectively.

- A relative functional gain of 0.018 and 0.021 for the restoration of the temporary work zones for the East Cape Extension and Homestead canals, respectively. The actual mitigation functional gain provided by this onsite restoration is 0.003 and 0.004 for the East Cape Extension and Homestead canals, respectively.
- A relative functional gain of 5.946 for the restoration of the temporary access channel in Lake Ingraham dredged to access the Homestead canal. The actual mitigation functional gain provided by this onsite restoration is 195.338.
- A relative functional gain of 0.053 for the interior marshes and 0.080 for Lake Ingraham. The actual mitigation functional gain provided by the mitigation sites was determined to be approximately 2,962.38 for the enhancement of approximately 55,894 acres of interior marsh and approximately 149.04 for the enhancement of approximately 1,863 acres of Lake Ingraham.

Thus, for the East Cape Extension canal, the total calculated functional gain for onsite restoration of 0.568 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.459; whereas, the total calculated functional loss for 0.092 acres of permanent impacts and 0.568 acres of temporary impacts to wetlands with implementing Alternative C is -0.069 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative C for the East Cape Extension canal.

Similarly, for the Homestead canal, the total calculated functional gain for onsite restoration of 33.925 acres and offsite enhancement of 57,757 acres of wetlands is 3,117.431; whereas, the total calculated functional loss for 0.106 acres of permanent impacts and 33.925 acres of temporary impacts to wetlands with implementing Alternative C is -8.868 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative C for the Homestead canal.

While all the environmental impacts of climate change would affect South Florida and Everglades National Park within the next century, the key concern for the lowlying Cape Sable area would be rising sea level, “with a very high likelihood” that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF, 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior freshwater and brackish marshes of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short-term to intermediate-term time frame by the construction of the proposed dam structure. The dams would reduce the intensity and duration of saltwater entering the interior freshwater and brackish Cape Sable marshes via the East Cape Extension and Homestead canals. The slowing or

postponement of impacts by the construction of a dam structure would allow time for the interior marshes of Cape Sable to restabilize and recover from the current impacts caused by the breached dams and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

2) Cumulative Impacts. No cumulative impacts to vegetation and wetlands would occur as a result of combining the cumulative projects with the actions contained in Alternative C because the effects of the cumulative projects would be negligible. Impacts to vegetation and wetlands would be limited only to those direct and indirect impacts resulting from implementation of Alternative C. For more information on the cumulative projects and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3 of the EA, respectively.

3) Conclusion. For Alternative C, construction activities would result in minor adverse, localized, direct effects on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternative C would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects. Thus, there would be no impairment of vegetation and wetlands as a result of the implementation of Alternative C.

Action Alternatives D (New 100' Plug – Marl Ridge Location) and G (New 370'/430' Plug - Marl Ridge Location)

1) Analysis. Under Alternative D, the existing dams would be removed and replaced with 100-foot plugs centered on the highest elevation point of the marl ridge along the East Cape Extension and Homestead canals (see Figures 4.1 and 4.2 in Section 4.1.4 of this document depicting the location of the preferred alternatives along the highest elevation points of the marl ridge for each of the canals). Under Alternative G, the existing dams would be removed and replaced with plugs the length of the approximate marl ridge along the East Cape Extension (370') and Homestead (430') canals. Wetland and surface water impacts are largely restricted to the immediate banks of the canals. Impact minimization efforts have been considered during this study to reduce impacts to the adjacent wetland/surface water systems to the maximum extent possible while maintaining safe and sound engineering and construction practices. Unavoidable wetland impacts would occur since the project is wetland dependent and constructed entirely within wetlands/surface waters. Unavoidable direct impacts (permanent and temporary) were quantified for Alternatives D and G based on the aerial extent of wetlands/surface waters within the proposed construction limits. The resulting quantities are depicted in Tables 5.5 and 5.6:

Table 5.5 – Direct Impacts to Wetlands/Surface Waters for Alternative D

	Wetland/Surface Water ID ³	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft ²)	Direct Wetland Impacts (acres)
East Cape Extension Canal	<i>E1UBLx</i>	Fill and Riprap - Permanent	East Cape Extension Canal	1,664.18	0.038
	<i>E1UBLx</i>	New Sheetpile - Permanent	East Cape Extension Canal	607.78	0.014
	<i>E1UBLx</i>	Plug Fill - Permanent	East Cape Extension Canal	5,470.78	0.126
	<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of East Cape Extension Canal	3,970.57	0.091
	<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of East Cape Extension Canal	499.90	0.011
	<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
	<i>E2SS3P/E2EMP</i>	Work Zone Clearing - Temporary	Banks of East Cape Extension Canal	8,551.11	0.196
Homestead Canal	<i>E1UBLx</i>	Fill and Riprap - Permanent	Homestead Canal	2,107.32	0.048
	<i>E1UBLx</i>	New Sheetpile - Permanent	Homestead Canal	445.64	0.010
	<i>E1UBLx</i>	Plug Fill - Permanent	Homestead Canal	4,105.33	0.094
	<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of Homestead Canal	3,127.24	0.072
	<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of Homestead Canal	563.75	0.013
	<i>E2SS3P/E2EMP</i>	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	8,337.40	0.191
	<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of Homestead Canal	38,798.32	0.891
	<i>E2SS3P/E2EMP</i>	Earthen Fill - Temporary	Southern Bank of Homestead Canal	1,077.88	0.025
	<i>E2USM/N</i>	Access Dredging - Temporary	Substrate of Lake Ingraham	1,431,040.00	32.852

³ Wetland/Surface Water identification codes define the type and characteristics of the wetland/surface water area. These codes are defined in detail in Section 3.4.1.3 of this document.

Table 5.6 – Direct Impacts to Wetlands/Surface Waters for Alternative G

	Wetland/Surface Water ID ⁴	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft ²)	Direct Wetland Impacts (acres)
East Cape Extension Canal	<i>E1UBLx</i>	Fill and Riprap - Permanent	East Cape Extension Canal	1,664.18	0.038
	<i>E1UBLx</i>	New Sheetpile - Permanent	East Cape Extension Canal	607.78	0.014
	<i>E1UBLx</i>	Plug Fill - Permanent	East Cape Extension Canal	5,470.78	0.126
	<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of East Cape Extension Canal	3,970.57	0.091
	<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of East Cape Extension Canal	499.90	0.011
	<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
	<i>E2SS3P/E2EMP</i>	Work Zone Clearing - Temporary	Banks of East Cape Extension Canal	8,551.11	0.196
Homestead Canal	<i>E1UBLx</i>	Fill and Riprap - Permanent	Homestead Canal	2,107.32	0.048
	<i>E1UBLx</i>	New Sheetpile - Permanent	Homestead Canal	445.64	0.010
	<i>E1UBLx</i>	Plug Fill - Permanent	Homestead Canal	4,105.33	0.094
	<i>E2SS3P/E2EMP</i>	Riprap - Permanent	Banks of Homestead Canal	3,127.24	0.072
	<i>E2SS3P/E2EMP</i>	New Sheetpile - Permanent	Banks of Homestead Canal	563.75	0.013
	<i>E2SS3P/E2EMP</i>	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	8,337.40	0.191
	<i>E2SS3P/E2EMP</i>	Mangrove Trimming - Temporary	Banks of Homestead Canal	38,798.32	0.891
	<i>E2SS3P/E2EMP</i>	Earthen Fill - Temporary	Southern Bank of Homestead Canal	1,077.88	0.025
	<i>E2USM/N</i>	Access Dredging - Temporary	Substrate of Lake Ingraham	1,431,040.00	32.852

Direct permanent impacts of 0.178 and 0.152 acres within surface waters of the East Cape Extension and Homestead canals, respectively, would occur as result of implementing Alternative D. Direct permanent impacts of 0.590 and 0.450 acres within surface waters of the East Cape Extension and Homestead canals, respectively, would occur as result of implementing Alternative G. These filling impacts are a direct result of the placement of the new sheetpile, earthen fill and riprap for the new plug, stabilization and armoring. Direct permanent impacts of 0.102 and 0.085 acres within wetlands along the banks of the East Cape Extension and Homestead canals, respectively, would also occur as a result of

⁴ Wetland/Surface Water identification codes define the type and characteristics of the wetland/surface water area. These codes are defined in detail in Section 3.4.1.3 of this document.

Alternative D. Direct permanent impacts of 0.084 and 0.085 acres within wetlands along the banks of the East Cape Extension and Homestead canals, respectively, would also occur as a result of Alternative G. These filling impacts are associated with the placement of the additional sheetpile needed for the deflector wingwalls as well as the placement of riprap for support and armoring. In addition to the above, less than 0.006 acres (250 square feet) of permanent shading impacts to both the East Cape Extension and Homestead canals would occur as a result of the proposed non-motorized boat (canoe/kayak) portage system with the implementation of either Alternative D or G. However, since no submerged aquatic vegetation are known to exist within these waterways, this new shading impact would be negligible. Also, floating mooring buoys and/or free-standing piles would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Mooring buoy anchors and/or piles would minimize potential substrate disturbance. As a result, the moorings would minimize potential secondary impacts to the canal bottom from the use of standard boat anchors. As stated above, since no submerged aquatic vegetation are known to exist within these waterways, the impacts associated with installation of the moorings are negligible.

To minimize wetland resource impacts, BMPs would be implemented during construction as discussed in the analysis for Alternative C, above. These practices would include employment of staked silt fence and turbidity barriers. The barriers would be employed in the canals prior to commencement of construction and maintained throughout the construction phase of the project. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted, etc.) and possibly replanted with native coastal wetland vegetation if regrowth does not occur naturally. The turbidity barriers and silt fence would be removed at the work areas in the canals once turbidity has subsided following construction completion of the dams.

Due to the space limitations in the work area, designated work zones have been established along the canal banks in which equipment would be staged for use during construction. Additional staging is anticipated to occur on floating barge(s) along the East Cape canal at the approximate location where the Ingraham canal branches off to the west and along the Homestead canal just west of the work zone. The barge(s) are anticipated to access the East Cape Extension canal through existing navigational channels and/or deep water areas of western Florida Bay, and Lake Ingraham and the Homestead canal through the Ingraham canal, Lower East Cape canal, and existing navigational channels and/or deep water areas of Florida Bay. The barge(s) would originate from a designated staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) due to a lack of a suitable staging area in Everglades National Park and to further meet the criteria for avoidance and minimization of impacts to wetland resources (see Figure 4.3 for the potential barge route). The exact location of the staging area in the Florida Keys would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). No adverse impacts to protected wetland resources are anticipated to occur as a result of utilizing the proposed accessways.

For the Homestead canal (only), barge(s) are anticipated to access the work zone with the dredging of a 52-foot wide by approximately 8,320 feet long temporary access channel through the shallow water depths within Lake Ingraham. Per NPS staff, the current water elevations at high tide in Lake Ingraham are up to two feet above existing substrate with

portions becoming exposed at low tide due to accelerated sediment deposition. Portions of the lake have transitioned from an open water system to a mud flat system in recent years (Wanless and Vlaswinkel, 2005). The channel would be dredged to a depth of approximately six feet below the mean low water elevation. To minimize impacts caused by dredging, a mechanical (bucket) dredge would be used. While both hydraulic and mechanical dredging methods can successfully remove the accumulated sediments within the channel, mechanically dredged sediment can be placed along the sides of the channel (less impact), versus hydraulic dredging which would require an off-site dewatering area and possible treatment equipment to allow dredge water effluent to be returned back to Lake Ingraham, which has the potential to result in moderate to major adverse impacts to the water quality of Lake Ingraham. For mechanical dredging operations within Lake Ingraham, accumulated sediments in the channel could be removed with a conventional barge-mounted long-reach excavator (40 to 60-ft reach). The width of the base of the dredged channel would not exceed 40 feet with anticipated 3:1 side slopes for a total top cross sectional channel width of approximately 52 feet. The dredged material (approximately 40,000 cubic yards) would be temporarily stockpiled in areas adjacent to the dredged channel outward to a maximum distance of approximately 60 feet on both sides [for a total temporary impact footprint of approximately 172 feet wide by 8,320 feet long (32.852 acres)]. Turbidity resulting from the dredging operation would be contained within the construction footprint using staked and/or floating turbidity curtains or other suitable barriers to minimize the potential for turbidity beyond the limits of construction. The barriers would be employed prior to commencement of construction activities and remain in place and regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs (see Water Resources section of EA for details on OFWs), a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). Upon completion of construction at the Homestead canal dam site, the dredged material in Lake Ingraham would be pulled back into the channel via mechanical means and the turbidity barriers would be removed once turbidity has subsided. Some of the dredged material would disperse beyond the turbidity barriers via tidal currents and wave energy; however, due to the lack of submerged aquatic vegetation in Lake Ingraham, the effect would be considered minor to negligible. The channel would be returned to pre-construction condition upon completion of construction. Per discussions with the regulatory agencies, since no protected submerged aquatic vegetation exists in the area to be dredged, the backfilling of the channel would serve as mitigation for dredging impacts to Lake Ingraham. Additionally, any resulting temporal functional losses due to this temporary impact would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior marshes of Cape Sable (see below for details).

In addition to dredging, trimming of overhanging mangrove trees may need to occur within the canals for barge access. Trimming would be conducted per the requirements of the FDEP's Mangrove Trimming Permit (to be acquired prior to commencement of construction). Approximately 0.415 acres (18,081.08 s.f.) along the East Cape Extension canal and 0.891 acres (38,798.32 s.f.) along the Homestead canal may require trimming (areas based on aerial coverage of vegetation over each waterway between the mouth of

each canal at Lake Ingraham and the existing dam site that would need to be trimmed to allow for barge access). Following construction completion, regrowth of the mangroves over the waterway would be left unrestricted and the area is expected to return to full functionality within five years.

The 0.196-acre work zone along the East Cape Extension canal and the 0.191-acre work zone along the Homestead canal for Alternative D and the 0.326-acre work zone along the East Cape Extension canal and the 0.343 work zone along the Homestead canal for Alternative G would be temporarily cleared of woody vegetation prior to construction. Following completion of construction, the work zone would be restored (e.g., regraded, compacted, etc.) to pre-existing conditions to facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area, native vegetation will be planted in the area. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of up to five years.

Per the results of the digital terrain model, one foot of earthen fill would need to be placed at the approximate location of the existing dam site along the southern bank of the Homestead canal (only). The fill is needed to bring an apparent low elevation area up to a higher grade to prevent a potential failure of the canal bank at this location (due to erosional processes) following construction of the new dam (see Section 4.1.4 of this document for further details). This activity would result in the temporary loss of wetland vegetation within an area of approximately 0.025 acres (1,077.88 s.f.). The area would also be planted with native wetland vegetation to reduce the potential for erosion. Since the resulting elevation would match existing adjacent grades, the area is expected to return to full functionality within five years. As a precaution, a monitoring/maintenance program would be initiated by the NPS in order to monitor and maintain the planted wetland vegetation in this area for a period of up to five years.

The areas to be affected by the physical footprint of the alternative are a mixture of regularly flooded mangrove wetlands and irregularly flooded shrub-scrub buttonwood/saltwort/mangrove wetlands as well as the open water area of the canal. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the canal.

A functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using UMAM (see above for description under Alternative C). Impacts to surface water areas with no protected submerged aquatic vegetation typically do not require mitigation, thus, a UMAM analysis was not performed for impacts to the waterways. A summary of the results of the assessment on the area to be permanently and temporarily impacted is provided in Tables 5.7 and 5.8, below. UMAM assessment forms for the impact areas have been provided at the end of this Wetland SOF for review.

Table 5.7 – UMAM Functional Assessment – Impacted Area - Alternative D

	Impact Area ID	Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
East Cape Extension Canal	Canal Banks – Filling	Perm	0.102 acres	0.667	0.500	-0.167	-0.017
	Canal Banks – Mangrove Trimming	Temp	0.415 acres	0.667	0.600	-0.067	-0.028
	Canal Banks – Work Zone Clearing	Temp	0.196 acres	0.700	0.533	-0.167	-0.033
Homestead Canal	Canal Banks – Filling	Perm	0.085 acres	0.667	0.500	-0.167	-0.014
	Canal Banks – Mangrove Trimming	Temp	0.891 acres	0.667	0.600	-0.067	-0.059
	Canal Banks – Work Zone Clearing	Temp	0.191 acres	0.700	0.533	-0.167	-0.032
	Southern Canal Bank – Filling	Temp	0.025 acres	0.667	0.500	-0.167	-0.004
	Lake Ingraham - Access Channel Dredging	Temp	32.852 acres	0.667	0.433	-0.233	-8.761

As shown in Table 5.7, the functional loss for 0.102 acres and 0.085 acres of permanent filling impacts to wetlands along the East Cape Extension and Homestead canals, respectively, was determined to be -0.017 and -0.014; and the functional loss for 0.196 acres and 0.191 acres of temporary impacts to wetlands as a result of vegetation clearing activities along the East Cape Extension and Homestead canals, respectively, was determined to be -0.033 and -0.032; and the functional loss for 0.025 acres of temporary impacts to wetlands as a result of raising the existing grade of an area along the southern bank of the Homestead canal was determined to be -0.004. The functional loss for temporary impacts to mangroves as a result of trimming activities and temporary impacts to Lake Ingraham as a result of dredging a temporary access channel are the same as what was calculated under Alternative C, above. Thus, for the East Cape Extension canal, the total functional loss as a result of Alternative D for 0.102 acres of permanent impacts and 0.611 acres of temporary impacts to wetlands is -0.078. In addition, for the Homestead canal, the total functional loss as a result of Alternative D for 0.085 acres of permanent impacts and 33.959 acres of temporary impacts to wetlands is -8.856.

Table 5.8 – UMAM Functional Assessment – Impacted Area - Alternative G

	Impact Area ID	Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
East Cape Extension Canal	Canal Banks – Filling	Perm	0.084 acres	0.667	0.500	-0.167	-0.014
	Canal Banks – Mangrove Trimming	Temp	0.415 acres	0.667	0.600	-0.067	-0.028
	Canal Banks – Work Zone Clearing	Temp	0.326 acres	0.700	0.533	-0.167	-0.054
Homestead Canal	Canal Banks – Filling	Perm	0.085 acres	0.667	0.500	-0.167	-0.014
	Canal Banks – Mangrove Trimming	Temp	0.891 acres	0.667	0.600	-0.067	-0.059
	Canal Banks – Work Zone Clearing	Temp	0.343 acres	0.700	0.533	-0.167	-0.057
	Southern Canal Bank - Filling	Temp	0.025 acres	0.667	0.500	-0.167	-0.004
	Lake Ingraham - Access Channel Dredging	Temp	32.852 acres	0.667	0.433	-0.233	-8.761

As shown in Table 5.8, the functional loss for 0.084 acres and 0.085 acres of permanent filling impacts to wetlands along the East Cape Extension and Homestead canals was determined to be -0.014 and -0.014; the functional loss for 0.326 acres and 0.343 acres of temporary impacts to wetlands as a result of vegetation clearing activities along the East Cape Extension and Homestead canals, respectively, was determined to be -0.054 and -0.057; and the functional loss for 0.025 acres of temporary impacts to wetlands as a result of raising the existing grade of an area along the southern bank of the Homestead canal was determined to be -0.004. The functional loss for temporary impacts to mangroves as a result of trimming activities and temporary impacts to Lake Ingraham as a result of dredging a temporary access channel are the same as what was calculated under Alternative C, above. Thus, for the East Cape Extension canal, the total functional loss as a result of Alternative G for 0.084 acres of permanent impacts and 0.741 acres of temporary impacts to wetlands is -0.096. In addition, for the Homestead canal, the total functional loss as a result of Alternative G for 0.085 acres of permanent impacts and 34.111 acres of temporary impacts to wetlands is -8.895.

All BMPs typically associated with NPS construction projects would be properly implemented and maintained throughout all construction activities minimizing short-term secondary impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing

zone upstream and downstream of the dam location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting, etc.) and placement of riprap on disturbed banks for stability.

The potential for long-term secondary impacts resulting from the project were also analyzed due to the lack of a vegetative buffer between the proposed dam sites and the adjacent wetlands. However, since the area is located in the backcountry of Everglades National Park and no active roadways or trails lead to this area, continued long-term disturbance at the dam sites is not anticipated. In addition, the potential for long-term, indirect, negligible to minor adverse impacts to the wetland areas directly adjacent to the existing dams would be remedied through the construction of canoe/kayak portages over the new dams. Details of the portage are discussed in Section 4.0 of this document. Thus, this observed activity is not anticipated to continue following dam construction, which provides a net benefit in relation to indirect/secondary impacts.

Furthermore, no adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be permanently impacted with construction of this alternative, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior marshes of Cape Sable (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of Alternative D or Alternative G (see above). This is evidenced through the use of the UMAM functional analysis as shown above in the analysis for Alternative C (the UMAM analysis for Lake Ingraham and the interior marshes is the same for all alternatives), which was used to assess the potential benefits to the interior marshes and Lake Ingraham (mitigation sites) derived as a result of the proposed project. In addition, the temporary impacts would be mitigated through onsite restoration activities as discussed above and a mitigation UMAM functional analysis was also performed for these temporary impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior marshes of Cape Sable. The results of this UMAM assessment is similar to the analysis for Alternative C; however, differ slightly due to the size of the temporary work zone per each alternative. The results of the UMAM analysis for the onsite restoration areas are shown below in Tables 5.9 and 5.10. UMAM assessment forms for the onsite restoration areas have been provided at the end of this Wetland SOF for review.

Table 5.9 – UMAM Functional Assess. for Onsite Restoration Areas – Alternative D

Mitigation Area ID		Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
East Cape Extension Canal	Mangrove Trimming Onsite Restoration	0.415 acres	0.600	0.667	0.067	1.14	1.25	0.047	0.019
	Temporary Work Zone Onsite Restoration	0.196 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.023
Homestead Canal	Mangrove Trimming Onsite Restoration	0.891 acres	0.600	0.667	0.067	1.14	1.25	.047	0.042
	Temporary Work Zone Onsite Restoration	0.191 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.022
	Southern Canal Bank Filling Area Restoration	0.025 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.003
	Access Channel Dredging Onsite Restoration	32.852 acres	0.433	0.667	0.233	1.03	1.25	0.181	5.946

The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation site) and risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) scores for the southern canal bank filling restoration area for the Homestead canal (only) listed in Table 5.9, above, were determined as follows:

Southern Canal Bank Filling Restoration Area (Homestead canal only): The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for growth of the mangrove/saltwort-dominated vegetation and to attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

The mitigation functional gain for the southern canal bank filling restoration area for the Homestead canal (only) was calculated as follows:

A relative functional gain [mitigation Delta / (risk x time lag)] for the restoration of the southern canal bank filling area (Homestead canal only) is 0.117. The actual mitigation functional gain (relative functional gain x acres) provided by this onsite restoration is 0.003.

Thus, for the East Cape Extension canal, the total calculated functional gain for onsite restoration of 0.611 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.487; whereas, the total calculated functional loss for 0.102 acres of permanent impacts and 0.611 acres of temporary impacts to wetlands as a result of implementing Alternative D is -0.078 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative D for the East Cape Extension canal.

Similarly, for the Homestead canal, the total calculated functional gain for onsite restoration of 33.934 acres and offsite enhancement of 57,757 acres of wetlands is 3,117.435; whereas, the total calculated functional loss for 0.085 acres of permanent impacts and 33.959 acres of temporary impacts to wetlands as a result of implementing Alternative D is -8.856 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative D for the Homestead canal.

Table 5.10 – UMAM Functional Assess. for Onsite Restoration Areas – Alternative G

Mitigation Area ID		Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
East Cape Extension Canal	Mangrove Trimming Onsite Restoration	0.415 acres	0.600	0.667	0.067	1.14	1.25	0.047	0.019
	Temporary Work Zone Onsite Restoration	0.326 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.038
Homestead Canal	Mangrove Trimming Onsite Restoration	0.891 acres	0.600	0.667	0.067	1.14	1.25	.047	0.042
	Temporary Work Zone Onsite Restoration	0.343 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.040

Mitigation Area ID	Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
Southern Canal Bank Filling Area Restoration	0.025 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.003
Access Channel Dredging Onsite Restoration	32.852 acres	0.433	0.667	0.233	1.03	1.25	0.181	5.946

Thus, for the East Cape Extension canal, the total calculated functional gain for onsite restoration of 0.741 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.479; whereas, the total calculated functional loss for 0.084 acres of permanent impacts and 0.741 acres of temporary impacts to wetlands as a result of implementing Alternative G is -0.096 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative G.

Similarly, for the Homestead canal, the total calculated functional gain for onsite restoration of 34.111 acres and offsite enhancement of 57,757 acres of wetlands is 3,117.453; whereas, the total calculated functional loss for 0.085 acres of permanent impacts and 34.111 acres of temporary impacts to wetlands as a result of implementing Alternative G is -8.895 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative G.

While all the environmental impacts of climate change would affect South Florida and Everglades National Park within the next century, the key concern for the lowlying Cape Sable area would be rising sea level, “with a very high likelihood” that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF, 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior freshwater and brackish marshes of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short-term to intermediate-term time frame by the construction of the proposed dam structure. The dams would reduce the intensity and duration of saltwater entering the interior freshwater and brackish Cape Sable marshes via the East Cape Extension and Homestead canals. The slowing or postponement of impacts by the construction of a dam structure would allow time for the interior marshes of Cape Sable to restabilize and recover from the current impacts caused by the breached dams and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

2) Cumulative Impacts. No cumulative impacts to vegetation and wetlands would occur as a result of combining the cumulative projects with the actions contained in Alternative D or G because the effects of the cumulative projects would be negligible. Impacts to vegetation and wetlands would be limited only to those direct and indirect impacts resulting from implementation of Alternative D or G. For more information on the cumulative projects and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3 of the EA, respectively.

3) Conclusion. For Alternative D or G, construction activities would result in minor adverse, localized, direct effects on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternative D or G would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects. Thus, there would be no impairment of vegetation and wetlands as a result of the implementation of Alternative D or G.

Action Alternatives D1 (New 100' Plug - Geotubes) and G1 (New 430' Plug - Geotubes)

These alternatives provide a construction option for the Homestead canal (only) that allows for further avoidance and minimization of impacts to wetland resources from Alternatives D and G through the avoidance of dredging a 52-foot wide by approximately 8,320 feet long navigational channel through Lake Ingraham. However, minor unavoidable wetland impacts would still occur since the project is wetland dependent and constructed entirely within wetlands/surface waters. Under Alternative D1, the existing dam would be removed and replaced with an approximate 100-foot plug centered on the highest elevation point of the marl ridge along the Homestead canal (see Figure 4.2 in Section 4.1.4 depicting the location of the preferred alternative along the highest elevation points of the marl ridge along the Homestead canal). Under Alternative G1, the existing dam would be removed and replaced with an approximate 430-foot plug filling the length of the approximate marl ridge along the Homestead canal. Wetland and surface water impacts are largely restricted to the immediate banks of the canal. Impact minimization efforts have been considered during this study to reduce impacts to the adjacent wetland/surface water systems to the maximum extent possible while maintaining safe and sound engineering and construction practices. Unavoidable direct impacts (permanent and temporary) were quantified for Alternative D1 and Alternative G1 based on the aerial extent of wetlands/surface waters within the proposed construction limits. The resulting quantities are depicted in Table 5.11, below:

Table 5.11 – Direct Impacts to Wetlands/Surface Waters for Alternatives D1 and G1

	Wetland/Surface Water ID ⁵	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft ²)	Direct Wetland Impacts (acres)
Alternative D1	E1UBLx	Fill and Riprap - Permanent	Homestead Canal	3,645.27	0.084
	E1UBLx	Geotubes - Permanent	Homestead Canal	2,262.73	0.052
	E1UBLx	Plug Fill - Permanent	Homestead Canal	4,505.56	0.103
	E2SS3P/E2EMP	Riprap - Permanent	Banks of Homestead Canal	1,394.25	0.032
	E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
	E2SS3P/E2EMP	Earthen Fill - Temporary	Southern Bank of Homestead Canal	1,077.88	0.025
	E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	5,473.93	0.126
Alternative G1	E1UBLx	Fill and Riprap - Permanent	Homestead Canal	3,645.27	0.084
	E1UBLx	Geotubes - Permanent	Homestead Canal	2,262.73	0.052
	E1UBLx	Plug Fill - Permanent	Homestead Canal	17,705.56	0.406
	E2SS3P/E2EMP	Riprap - Permanent	Banks of Homestead Canal	1,394.25	0.032
	E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of Homestead Canal	38,798.32	0.891
	E2SS3P/E2EMP	Earthen Fill - Temporary	Southern Bank of Homestead Canal	1,077.88	0.025
	E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	23,600.81	0.542

Direct permanent impacts of 0.239 acres within surface waters of the canal would occur as result of implementing Alternative D1 and direct permanent impacts of 0.542 acres within surface waters of the canal would occur as result of implementing Alternative G1. These filling impacts are a direct result of the placement of the geotubes, earthen fill and riprap for the new plug, stabilization and armoring. Direct permanent impacts of 0.032 acres within wetlands along the banks of the canal would also occur as a result of implementing Alternative D1 and direct permanent impacts of 0.032 acres within wetlands along the

⁵ Wetland/Surface Water identification codes define the type and characteristics of the wetland/surface water area. These codes are defined in detail in Section 3.4.1.3 of this document.

banks of the canal would also occur as a result of implement Alternative G1. These filling impacts are associated with the placement of riprap for slope support and armoring of the geotubes. Also, floating mooring buoys and/or free-standing piles would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Mooring buoy anchors and/or piles would minimize potential substrate disturbance. As a result, the moorings would minimize potential secondary impacts to the canal bottom from the use of standard boat anchors. Since no submerged aquatic vegetation is known to exist within these waterways, the impacts associated with installation of the moorings are negligible.

To minimize wetland resource impacts, BMPs would be implemented during construction as discussed in the analysis for Alternative C, above. These practices would include employment of staked silt fence and turbidity barriers. The barriers would be employed in the Homestead canal prior to commencement of construction and maintained throughout the construction phase of the project. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted, etc.) and possibly replanted with native coastal wetland vegetation if regrowth does not occur naturally. The turbidity barriers and silt fence would be removed from the canal/work area once turbidity has subsided following construction completion of the dam.

Due to the space limitations in the work area, a designated work zone has been established along the canal banks in which small equipment and materials would be staged for use during construction. Additional staging is anticipated to occur on floating barge(s) at the western terminus of the Ingraham canal (eastern mouth of Lake Ingraham). This additional staging area is required due to access restrictions from this location to the work area along the Homestead canal (i.e., very shallow water depths within Lake Ingraham). Per NPS staff, the current water elevations at high tide in Lake Ingraham are up to two feet above existing substrate with portions becoming exposed at low tide due to accelerated sediment deposition. Portions of the lake have transitioned from an open water system to a mud flat system in recent years (Wanless and Vlaswinkel 2005). Therefore, in order to avoid dredging impacts to Lake Ingraham, fill material would be transported to the Homestead canal work area through a constructed floating pipeline. Since the pipeline would be floating on top of the lake waters, no adverse impacts to the lake are anticipated to occur from this activity. The 6-8 inch pipeline would be constructed using a shallow draft barge and would run from the work area to a larger barge located at the designated staging area at the western terminus of the Ingraham canal for a distance of approximately two miles. The use of the shallow draft barge is not anticipated to require dredging of the lake. Fill material would be transported to the staging area at the Ingraham canal and conveyed through the pipe via hydraulic pumping to the work area at the Homestead canal to fill the geotubes and plug. Riprap (armoring materials) would be transported to the work area using a helicopter (see Section 4.0 for further details regarding this alternative). The barge(s) are anticipated to access the Ingraham canal through the Lower east Cape canal and existing navigational channels and/or deep water areas of western Florida Bay originating from a designated staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) due to a lack of a suitable staging area in Everglades National Park and to further meet the criteria for avoidance and minimization of impacts to wetland resources (see Figure 4.3 for the potential barge route). The exact location of the staging area in the Florida Keys would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands

(i.e., parking lot, paved area, previously filled area, etc.). No adverse impacts to protected wetland resources are anticipated to occur as a result of utilizing the Ingraham canal as a staging area.

Trimming of overhanging mangrove trees may need to occur within the canals for barge access. Trimming would be conducted per the requirements of the FDEP's Mangrove Trimming Permit (to be acquired prior to commencement of construction). Approximately 0.415 acres (18,081.08 s.f.) along the East Cape Extension canal and 0.891 acres (38,798.32 s.f.) along the Homestead canal may require trimming (areas based on aerial coverage of vegetation over each waterway between the mouth of each canal at Lake Ingraham and the existing dam site that would need to be trimmed to allow for barge access). Following construction completion, regrowth of the mangroves over the waterway would be left unrestricted and the area is expected to return to full functionality within five years.

The 0.126-acre temporary work zone for Alternative D1 and the 0.542-acre temporary work zone for Alternative G1 along the Homestead canal would be temporarily cleared of woody vegetation prior to construction. Following completion of construction, the work zone would be restored (e.g., regraded, compacted, etc.) to pre-existing conditions to facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area, native vegetation will be planted in the area. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of up to five years.

Per the results of the digital terrain survey, one foot of earthen fill would need to be placed at the approximate location of the existing dam site along the southern bank of the Homestead canal (only). The fill is needed to bring an apparent low elevation area up to a higher grade to prevent a potential failure of the canal bank at this location (due to erosional processes) following construction of the new dam (see Section 4.1.4 of this document for further details). This activity would result in the temporary loss of wetland vegetation within an area of approximately 0.025 acres (1,077.88 s.f.). The area would also be planted with native wetland vegetation to reduce the potential for erosion. Since the resulting elevation would match existing adjacent grades, the area is expected to return to full functionality within five years. As a precaution, a monitoring/maintenance program would be initiated by the NPS in order to monitor and maintain the planted wetland vegetation in this area for a period of up to five years.

The area to be affected by the physical footprint of the alternative is a mixture of regularly flooded mangrove wetlands and irregularly flooded shrub-scrub buttonwood/saltwort/mangrove wetlands as well as the open water area of the canal. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the canal.

A functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using UMAM (see above for description under Alternative C). Impacts to surface water areas with no protected submerged aquatic vegetation typically

do not require mitigation, thus, a UMAM analysis was not performed for impacts to the waterway itself. A summary of the results of the assessment on the areas to be permanently and temporarily impacted is provided in Table 5.12, below. UMAM assessment forms for the impact areas have been provided at the end of this Wetland SOF for review.

Table 5.12 – UMAM Functional Assess. – Impacted Area - Alternatives D1 and G1

	Impact Area ID	Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
Alternative D1	Canal Banks – Filling	Perm	0.032 acres	0.667	0.500	-0.167	-0.005
	Canal Banks – Mangrove Trimming	Temp	0.415 acres	0.667	0.600	-0.067	-0.028
	Southern Canal Bank – Filling	Temp	0.025 acres	0.667	0.500	-0.167	-0.004
	Canal Banks – Work Zone Clearing	Temp	0.126 acres	0.700	0.533	-0.167	-0.021
Alternative G1	Canal Banks – Filling	Perm	0.032 acres	0.667	0.500	-0.167	-0.005
	Canal Banks – Mangrove Trimming	Temp	0.891 acres	0.667	0.600	-0.067	-0.059
	Southern Canal Bank – Filling	Temp	0.025 acres	0.667	0.500	-0.167	-0.004
	Canal Banks – Work Zone Clearing	Temp	0.542 acres	0.700	0.533	-0.167	-0.091

As shown in Table 5.12, the functional loss for 0.032 acres of permanent filling impacts to wetlands along the Homestead canal for both alternatives was determined to be -0.005; and the functional loss for 0.126 acres and 0.542 acres of temporary impacts to wetlands as a result of vegetation clearing activities along the Homestead canal for Alternative D1 (NPS Preferred Alternative for the Homestead canal) and Alternative G1, respectively, was determined to be -0.021 and -0.091. The functional loss for temporary impacts to mangroves as a result of trimming activities and for temporary impacts resulting from the need to raise the existing grade of an area along the southern bank of the Homestead canal for both alternatives are the same as what was calculated under the analysis for Alternatives D and G, above. Thus, the total functional loss as a result of Alternative D1 (NPS Preferred Alternative for the Homestead canal) for 0.032 acres of permanent impacts and 0.566 acres of temporary impacts to wetlands is -0.058. In addition, the total functional

loss as a result of Alternative G1 for 0.032 acres of permanent impacts and 1.458 acres of temporary impacts to wetlands is -0.159.

The UMAM analysis indicates that the wetland areas have a score of 0.667, which falls within the moderate quality range, between 0.50 and 0.79. Wetlands assigned UMAM scores less than 0.50 are typically highly disturbed and have limited wetland functions. Wetlands assigned UMAM scores greater than 0.79 are typically high quality wetlands with sustained wetland functions.

All BMPs typically associated with NPS construction projects would be properly implemented and maintained throughout all construction activities minimizing short-term secondary impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing zone upstream and downstream of the dam locations in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting, etc.) and placement of riprap on disturbed banks for stability.

The potential for long-term secondary impacts resulting from the project were also analyzed due to the lack of a vegetative buffer between the proposed dam site and the adjacent wetlands. However, since the area is located in the backcountry of Everglades National Park and no active roadways or trails lead to this area, continued long-term disturbance at the dam sites is not anticipated. In addition, the potential for long-term, indirect, negligible to minor adverse impacts to the wetland areas directly adjacent to the existing dams would be remedied through the construction of canoe/kayak portages over the new dams. Details of the portage are discussed in Section 4.0 of this document. Thus, this observed activity is not anticipated to continue following dam construction, which provides a net benefit in relation to indirect/secondary impacts.

Furthermore, no adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be impacted with construction of this alternative, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior marshes of Cape Sable (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of Alternative D1 or Alternative G1 (see above). This is evidenced through the use of the UMAM functional analysis as shown above in the analysis for Alternatives D and G (the UMAM analysis for Lake Ingraham and the interior marshes is the same for all alternatives), which was used to assess the potential benefits to the interior marshes and Lake Ingraham (mitigation sites) derived as a result of the proposed project. In addition,

the temporary impacts would be mitigated through onsite restoration activities as discussed above and a mitigation UMAM functional analysis was also performed for these temporary impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior marshes of Cape Sable. The results of this UMAM assessment is similar to the analysis for Alternatives D and G; however, differ slightly due to the size of the temporary work zone per each alternative. The results of the UMAM analysis for the onsite restoration areas are shown below in Table 5.13. UMAM assessment forms for the onsite restoration areas have been provided at the end of this Wetland SOF for review.

Table 5.13 – UMAM Functional Assess. for Onsite Restoration Areas – Alternatives D1 and G1

Mitigation Area ID	Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)	
Alternative D1	Mangrove Trimming Onsite Restoration	0.415 acres	0.600	0.667	0.067	1.14	1.25	0.047	0.019
	Southern Canal Bank Filling Area Restoration	0.025 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.003
	Temporary Work Zone Onsite Restoration	0.126 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.015
Alternative G1	Mangrove Trimming Onsite Restoration	0.891 acres	0.600	0.667	0.067	1.14	1.25	.047	0.042
	Southern Canal Bank Filling Area Restoration	0.025 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.003
	Temporary Work Zone Onsite Restoration	0.542 acres	0.533	0.700	0.167	1.14	1.25	0.117	0.063

Thus, for Alternative D1, the total calculated functional gain for onsite restoration of 0.566 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.459; whereas, the total calculated functional loss for 0.032 acres of permanent impacts and 0.566 acres of

temporary impacts to wetlands is -0.058 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative D1.

Similarly, for Alternative G1, the total calculated functional gain for onsite restoration of 1.458 acres and offsite enhancement of 57,757 acres of wetlands is 3,117.530; whereas, the total calculated functional loss for 0.032 acres of permanent impacts and 1.458 acres of temporary impacts to wetlands is -0.159 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative G1.

While all the environmental impacts of climate change would affect South Florida and Everglades National Park within the next century, the key concern for the lowlying Cape Sable area would be rising sea level, “with a very high likelihood” that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF, 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior freshwater and brackish marshes of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short-term to intermediate-term time frame by the construction of the proposed dam structure. The dams would reduce the intensity and duration of saltwater entering the interior freshwater and brackish Cape Sable marshes via the East Cape Extension and Homestead canals. The slowing or postponement of impacts by the construction of a dam structure would allow time for the interior marshes of Cape Sable to restabilize and recover from the current impacts caused by the breached dams and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

2) Cumulative Impacts. No cumulative impacts to vegetation and wetlands would occur as a result of combining the cumulative projects with the actions contained in Alternative D1 or Alternative G1 because the effects of the cumulative projects would be negligible. Impacts to vegetation and wetlands would be limited only to those direct and indirect impacts resulting from implementation of Alternative D1 or Alternative G1. For more information on the cumulative projects and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3 of the EA, respectively.

3) Conclusion. For Alternative D1 or Alternative G1, construction activities would result in minor adverse, localized, direct effects on vegetation. However, these action alternatives would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park’s master plan or other NPS planning documents. Alternative D1 or Alternative G1 would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects. Thus, there would

be no impairment of vegetation and wetlands as a result of the implementation of Alternative D1 or Alternative G1.

5.3 Justification for Use of Wetlands

There are no practicable non-wetland alternatives for the construction component of the proposed action. The purpose of the project is to provide sustainable solutions to issues associated with saltwater intrusion into and degradation of freshwater and brackish marshes north of the marl ridge; illegal motorized boat access into the Marjory Stoneman Douglas Wilderness area; and unsafe conditions for motorized and non-motorized boaters at the dam sites. All areas within the study area are designated wetlands. No alternative non-wetland locations exist in the area of where the dams would function sufficiently.

6.0 COMPLIANCE

Clean Water Act Section 404

The proposed actions impact waters of the United States as defined by the Clean Water Act and are therefore subject to review by the U.S. Army Corps of Engineers. The Clean Water Act Section 404 regulates the discharge of dredged or fill material into waters of the United States. This review is conducted concurrent with the Section 10 Rivers and Harbors Act (see below) permitting process. Before moving forward with this project, NPS anticipates applying for a Section 404/Section 10 permit.

Before moving forward with this project, NPS anticipates applying for a Section 404 permit.

Rivers and Harbors Act Section 10

Section 10 of the Rivers and Harbors Act (33 U.S.C. 401 *et seq.*) requires authorization from the U.S. Army Corps of Engineers (USACE) for the construction of any structure in or over any navigable water of the United States, the excavation/dredging or deposition of material in these water or any obstruction or alteration in a "navigable water". The proposed actions include the construction of a structure within navigable waters of the United States as defined by the Rivers and Harbors Act and are therefore subject to review by the USACE. This review is conducted concurrent with the Section 404 Clean Water Act (see above) permitting process. Before moving forward with this project, NPS anticipates applying for a Section 404/Section 10 permit.

Coastal Zone Management Act

The proposed actions impact coastal resources as defined by the Coastal Zone Management Act (CZMA) (16 U.S.C. §§1451 *et. seq.*) and are therefore subject to review by the FDEP under the Florida Coastal Management Program (FCMP), the State of Florida's federally approved management program. The State of Florida's coastal zone includes the area encompassed by the state's 67 counties and its territorial seas. Therefore, federal actions occurring throughout the state are reviewed by the State for consistency with the FCMP. However, the State has limited its federal consistency review of federally licensed and permitted activities to the federal licenses or permits specified in Section 380.23(3)c, Florida Statutes. This review is conducted concurrent with the FDEP's Environmental Resource Permitting process. Before moving forward with this project, NPS anticipates applying for an Environmental Resources Permit from the State of Florida.

7.0 CONCLUSION

The NPS finds that there are no practicable alternatives to disturbing wetlands along the Cape Sable Extension and Homestead canals in the Cape Sable area. Wetlands have been avoided to the maximum practicable extent, and the wetland impacts that could not be avoided would be minimized. Unavoidable impacts to wetlands would be compensated for through the immediate and long-term wetland functional benefits associated with the proposed project. Table 7.1, below, summarizes the wetland impacts per each alternative. Alternative A (no action) is excluded from the summary table since this alternative would sustain the anthropomorphic impacts on erosional processes within these canals and the greater Cape Sable area and does not meet the objectives of the proposed project.

Table 7.1 – Summary of Wetland Impacts for Action Alternatives

Alternative ID		Permanent Impacts	Temporary Impacts	Total Impacts
East Cape Extension Canal	Alternative C	0.092 acres	0.568 acres	0.660 acres
	Alternative D	0.102 acres	0.611 acres	0.713 acres
	Alternative G	0.084 acres	0.741 acres	0.825 acres
Homestead Canal	Alternative C	0.106 acres	33.935 acres	34.041 acres
	Alternative D	0.085 acres	33.959 acres	34.044 acres
	Alternative G	0.085 acres	34.111 acres	34.196 acres
	Alternative D1	0.032 acres	0.566 acres	0.598 acres
	Alternative G1	0.032 acres	1.458 acres	1.490 acres

Based on the analysis of all of the proposed action alternatives, Alternative C was determined to have the least impact (permanent and temporary) on wetland resources for the Cape Sable Extension canal and Alternative D1 was determined to have the least impact on wetland resources for the Homestead canal.

The preferred alternative for the Homestead canal was determined to be Alternative D1, which coincides with the wetland analysis. However, the preferred alternative for the East Cape Extension canal was determined to be Alternative D, which was determined to result in 0.053 acres of additional wetland impact (compared to Alternative C). Alternative D was chosen over Alternative C due to the alternative's greater ability to meet the purpose,

needs and objectives of the proposed project, in particular, the ability to function for a 50-year life-cycle to prevent the loss of natural and cultural resources; provide greater visitor enjoyment; and improve the efficiency of other Park operations. Please reference the VA/CBA report in the appendices of the EA for further details.

It must be noted that the overall benefit to local and regional wetlands in the greater Cape Sable area (total wetland functional gain) as a result of the construction of any action alternative presented herein was determined to far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no matter which alternative is constructed, the project would provide a net benefit to wetlands in the greater Cape Sable area of Everglades National Park.

8.0 REFERENCES

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