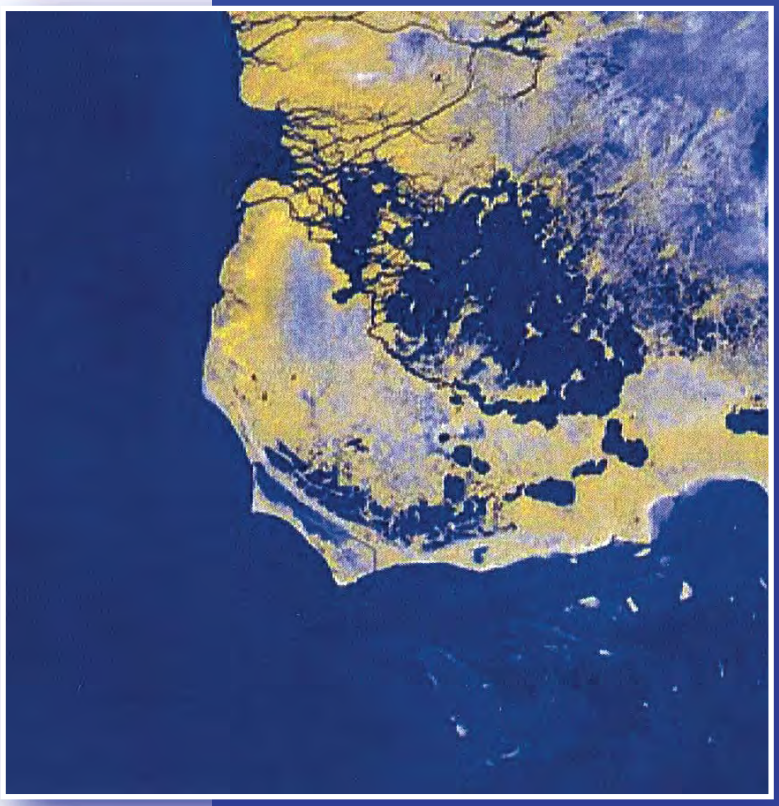
Chapter 3
Affected Environment and Environmental Consequences



CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This chapter of the environmental assessment describes existing environmental conditions in the areas potentially affected by the alternatives and the impacts to those environmental conditions as a result of implementation of the alternatives. This section addresses the following impact topics: geologic resources/soils, water resources, wildlife and habitat, special status species, wilderness, cultural resources, visitor use and experience/public safety, and park management and operations.

For each impact topic listed above, the existing condition, or "affected environment", is first provided. This is followed by the "environmental consequences", or potential impacts, of each of the alternatives (or groupings of alternatives if impacts are similar in nature) to each of the resources or values (i.e., impact topics). This section analyzes both beneficial and adverse impacts that would result from the implementation of any of the alternatives considered. This section also summarizes the laws and policies relevant to each impact topic and explains the general methodology used to analyze impacts, including definitions of impact thresholds for measuring the intensity of impacts. In addition, an assessment of cumulative impacts is included for each topic. An assessment of whether or not impairment of a resource would occur is also provided for natural and cultural resources.

3.2 Methodology for Establishing Impact Thresholds and Measuring Effects by Resource

The general approach for measuring the effects of the alternatives on each resource category includes general analysis methods as described in guiding regulations, basic assumptions, thresholds used to define the level of impact resulting from each alternative, methods used to evaluate the cumulative effects, and the methods and thresholds used to determine if impairment would occur for those applicable impact topics. The analysis of impacts follows Council on Environmental Quality (CEQ) guidelines and Director's Order #12 procedures (NPS 2001).

3.2.1 General Analysis Methods

Potential impacts of all alternatives are described in terms of type (Are the effects beneficial or adverse?); context (Are the effects site-specific, local, or regional?); duration (Are the effects short-term or long-term?); and intensity (Are the effects negligible, minor, moderate, or major?). Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. In some cases, alternatives were grouped together in the analysis when impacts were determined to be similar in order to minimize redundancy.

Each alternative is compared to a baseline to determine the context, duration, and intensity of the resource impacts. For purposes of the impact analysis, the baseline is the existing conditions (No Action Alternative) at the East Cape Extension and Homestead canal dams. In the absence of quantitative data, best professional judgment was used to determine impacts. In general, impacts were determined using existing literature, federal and state standards, and consultation with subject matter experts and park staff and other agencies.

For the purposes of analysis the following assumptions are used for all impact topics:

***Beneficial*:** A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

***Adverse*:** A change that declines, degrades, and/or moves the resource away from a desired condition or detracts from its appearance or condition.

***Context*:** Context is the affected environment within which an impact would occur, such as local, park-wide, regional, global, affected interests, society as whole, or any combination of these. Context is variable and depends on the circumstances involved with each impact topic.

***Duration*:** The duration of the impact varies according to the impact topic evaluated. However, for the purposes of this analysis, the following assumptions are used for all impact topics except cultural resources:

Short-term impacts: Those impacts occurring in the immediate future or during plan implementation (usually from one to six months, or up to one year). For natural systems (vegetation, wildlife, wetlands), recovery would take less than one year;

Long-term impacts: Those impacts occurring after plan implementation, through the next 10 years; for natural systems (vegetation, wildlife, wetlands), recovery would take more than one year; and

Because most cultural resources are non-renewable, impacts to most cultural resources are considered long-term, except those for the natural elements of cultural landscapes that would renew such as vegetation; effects would be short-term (three to five years) until natural components are replaced (e.g., new vegetation grows).

***Intensity*:** Because definitions of impact intensity (negligible, minor, moderate, and major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed.

Summary tables of environmental consequences for the East Cape Extension and Homestead canals have been provided at the end of Chapter 2.

3.2.2 Assumptions

3.2.2.1 Analysis Area

The area of analysis for all topics is described under each topic and may include either the primary area adjacent to the existing failed East Cape Extension and Homestead canal dams (see Figures 1.3 and 1.4, respectively) or the expanded greater Cape Sable area (see Figure 1.5).

3.2.3 Cumulative Impacts Analysis

NEPA regulations require an assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ Handbook (1997), “Considering Cumulative Effects,” cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful.

The Cape Sable area is a remote and isolated region of the park. Known past, present, and reasonably foreseeable future actions are limited. Several projects and actions that would have

an impact on park resources in relationship to the restoration of the dams at the East Cape Extension and Homestead canals are presented and briefly described in Section 1.4.5 of Chapter 1. Presented below is an explanation of the types and intensities of impacts anticipated from these projects and actions, all of which would be considered negligible.

- **General management plan (GMP)** – The general management plan is a long-term programmatic plan that includes desired conditions and management direction for park resources. It provides broad direction for land use and visitor management, but does not include information on site specific treatments or restoration activities. Those activities and their potential environmental effects would be detailed in follow-on implementation plans with accompanying NEPA documentation. The GMP would have negligible impacts on resources within the project area and the region.
- **Exotic vegetation management** – Exotic vegetation management activities, such as the use of fire and chemical, mechanical, and biological treatments, would have short-term, localized, adverse impacts on some resources in the project area; however, beneficial impacts would occur in localized areas over the long-term. Overall, the effects of sporadic exotic vegetation management in the project area and in the region would be negligible.
- **Hydrologic restoration activities** – There are several current and future projects designed to improve water delivery to the South Florida region and the Everglades system: namely the Comprehensive Everglades Restoration Plan (CERP), the Modified Water Delivery (Mod Waters) project, and the Tamiami Trail 2 project. Each of these has the goal of improving and restoring freshwater flows to the Everglades region, including the park. Implementation of CERP would take more than 30 years to complete and is anticipated to cost in excess of $15 billion. If key CERP projects are successfully implemented, the park would experience improvements to the quality, quantity, timing and distribution of water flows. Similarly, the Mod Waters project is designed to improve surface flow to ecosystems within the northern portion of the park. The Tamiami Trail 2 project would convey freshwater to regions south of the Tamiami Trail by redesigning the roadway to convey unrestricted freshwater flows. Each of these projects is designed to improve water flow; however, their success and impact on resources in the park and the region are unknown. Furthermore, given the location of the Cape Sable area and the project site in relation to these cumulative projects, the impact and influence on resources within the region and the local project area would likely be undetectable and thus negligible.
- **Visitor use and experience projects** – Projects to provide visitor opportunities or enhance visitor experience in the region would not be observably affected by projects such as the Florida Circumnavigation Saltwater Paddling Trail. The impact to visitor use and experience in the project area and the region would be negligible.

As identified above, it was determined that these cumulative projects and actions would have only negligible impacts on resources in the project area, and that the actions included as part of the alternatives in this plan would contribute only a negligible increment to the overall impact on resources within the region. Accordingly, cumulative effects were considered to be so small as to be imperceptible, and thus discountable. Therefore, no cumulative impacts are anticipated as a result of this project and a detailed analysis is not included in this EA.

3.2.4 Impairment Analysis

The NPS *Management Policies 2006* requires an analysis of potential effects to determine whether or not actions would impact park resources, but it also must determine whether those

actions would impair park resources. The fundamental purpose of the national park system, as established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. These laws give the NPS the managerial discretion to allow park resources and values to be impacted when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values.

The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question, and other impacts. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents as being of significance.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

An impairment determination is included in the conclusion statement for all impact topics related to Everglades National Park natural and cultural resources. Impairment determinations are not made for health and safety or park operations and management because impairment findings relate back to park resources and values, and these impact areas are not generally considered to be park resources or values. Impairment determinations are not made for visitor use and experience because, according to the Organic Act, enjoyment cannot be impaired in the same way an action would impair park resources and values.

3.2.5 Climate Change and Sea Level Rise

Climate change and the resulting sea level rise are affecting all of South Florida, especially the lowlying Cape Sable area. Cape Sable evolved following a rapid rise in sea level 2,500 to 2,400 years ago (Wanless and Vlaswinkel, 2005). For the past 2,500 years, South Florida has experienced an average rate of relative sea level rise of about 1.5 inches per century (CCATF, 2008). This gradual sea level rise allowed for areas such as Cape Sable to stabilize and expand with the rising sea level. Since 1932, relative sea level rise has increased six-fold due to regional changes in the density and circulation of North Atlantic shallow and deep waters (Wanless and Vlaswinkel, 2005). The 9-inch rise in sea level since 1932 has destabilized all of Cape Sable's coastal and wetland environments, greatly increasing the area and volume of water that incoming tides cover (Wanless and Vlaswinkel, 2005).

The 2001 report of the United Nations sponsored Intergovernmental Panel on Climate Change (IPCC) projected an additional sea level rise over the coming century of one to three feet

(median sea level rise of two feet) (CCATF, 2008). The 2007 IPCC report projected a somewhat lower level, but it did not incorporate the substantially accelerated melting being observed in the Greenland Ice Sheet (CCATF, 2008). The recent changes occurring in the Arctic and Greenland mean that global warming and sea level rise would happen much more rapidly than had been only recently projected (CCATF, 2008). Even recent model projections of future ice melt for Greenland by 2040 have already occurred (CCATF, 2008). As a result, the IPCC report underestimates the amount of sea level rise that is likely to occur in this century (CCATF 2008).

In the Antarctic, there is no inherent reason why the impacts of global warming should follow the pattern of the Arctic Ocean (CCATF, 2008). Nevertheless, there has been a gradual loss of pack ice through the last half of the twentieth century, but a slight expansion in the past decade (as anticipated by climate models); about a 12% increase in the flow rate of 300 glaciers around the margin of Antarctica between 1993 and 2003; and a substantial increase in summer snow melt in both marginal and interior areas of the ice sheet since 2005 (CCATF, 2008). Antarctica is a critical unknown to future projections; however, it is showing distinctive early signatures of accelerated ice release (CCATF, 2008).

The *Second Report and Initial Recommendations* published by the Miami-Dade CCATF states that global warming would result in many changes to the natural environment, “including changing atmospheric circulation and temperature patterns, changes in rainfall and severe weather, changes in biologic community distribution, increased extinction rates, changes in disease and pest distribution, and changes in sea level” (CCATF, 2008). While all these environmental impacts 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).

While slowing the rate of sea level rise is beyond the resources of the park, monitoring sea level change and evaluating and predicting impacts on the park’s landscape is a valid management issue. The freshwater marshes and brackish estuaries are under constant threat of inundation by the sea. Given the low relief of the park, this rise would destroy much of the marsh landscape protected at the park. The effects of sea level rise would also impact the dams in the East Cape Extension and Homestead canals.

The IPCC is considered the foremost authority for climate change worldwide. The IPCC is a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to “provide the decision-makers and other interested in climate change with an objective source of information about climate change” (IPCC 2009). “The IPCC does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess on a comprehensive, objective, open, and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation” (IPCC 2009).

Locally, the Miami-Dade County CCATF was established in 2006 with the charge of identifying potential future climate change impacts to Miami-Dade County and providing ongoing recommendations regarding mitigation and adaptation measures to respond to climate change (Miami-Dade 2009). The CCATF’s 25 appointed members represent a diverse, multidisciplinary and highly knowledgeable group of individuals, including the Superintendent of Everglades National Park (Miami-Dade 2009). Since Everglades National Park is located largely within Miami-Dade County, the advice of the CCATF applies to the park’s resources.

A two-foot sea level rise by the end of the century, as projected in the 2001 IPCC report, would drastically change the landscape of South Florida and Everglades National Park (CCATF,

2008). Spring high tides would be +4.5 to 5 feet above present mean sea level; storm surges would be higher; barrier islands, fill islands and low-lying mainland areas would be frequently flooded; salt water intrusion would restrict available freshwater resources; and drainage would be more sluggish (CCATF 2008). Based on the Miami-Dade County CCATF 2008 report, it is anticipated that sea level within the next century would rise substantially more than the IPCC's projected two feet. Many respected scientists, as documented in the CCATF's 2008 report, now see a likely sea level rise of at least 1.5 feet in the next 50 years and a total of at least three to five feet by the end of the century, with the potential for a larger rise. With this scenario, spring high tides would be at +6 to +8 feet (CCATF 2008). This estimate also does not take into account the possibility of a catastrophically rapid melt of land-bound ice from Greenland, and it makes no assumptions about Antarctica (CCATF 2008). The IPCC is not expected to revisit these estimates until 2012; therefore, the current estimates must be taken into account in the analysis of the dam restoration alternatives.

It is important to note that climate change and sea level rise research is not an exact science and there is not a complete consensus on the estimates, as shown in the two IPCC reports and the Miami-Dade County CCATF report referenced above.

3.3 Geology, Topography, and Soils

3.3.1 Affected Environment

Everglades National Park is located at the southern tip of the Florida peninsula. In general, this area consists of very low, flat topography that is comprised mainly of limestone, which is relatively soft, permeable and prone to erosion (Crisfield et al., 2005). The lower freshwater Everglades is defined by two subtle limestone topographic highs, a Pliocene ridge to the northwest and a Pleistocene ridge to the southeast. These two limestone features create a gently sloping vertical gradient that directs the lower Everglades surficial hydrologic sheet flow towards Cape Sable (Wanless and Vlaswinkel, 2005).

The mainland portion of Everglades National Park overlies the unconfined Surficial Aquifer System (SAS), which consists of Miocene to Holocene age siliciclastic and carbonate sediments and varies in thickness from 165 feet to 270 feet. It contains two named carbonate aquifers (Gray Limestone Aquifer and Biscayne Aquifer) and two layers of siliciclastic sediments. The Hawthorn Group forms the base of the SAS. The 550 to 800 foot thick sequence of low permeable sediments of the Hawthorn Group make it an effective confining unit for the underlying Floridan Aquifer System. In South Florida, the Floridan Aquifer occurs between depths of 820 and 3,280 feet below the land surface and is artesian with a potentiometric surface of about 40 feet above the land surface. The Biscayne Aquifer forms the top of the SAS, and is the principle source of water supply for South Florida. The Biscayne Aquifer is an unconfined karst aquifer dominantly composed of highly porous units of the Fort Thompson and Miami Limestone Formations with the Key Largo formation inter-fingering in some areas. The Biscayne aquifer contains high permeability limestone and calcareous sand units and ranges in thickness from 0 to 80 feet, increasing in thickness toward the east. In many portions of Everglades National Park, the Biscayne Aquifer is overlain by marl and peat deposits (Price, 2003).

Evidence suggests that coastal flooding occurred approximately 2,800 to 2,000 years ago, accompanied by rapid sedimentation, which resulted in a series of coastal marl ridges. These firm tan ridges are composed of detritus and calcium carbonate mud (marl) overlying a sequence of grey marl followed by pleistocene limestone bedrock at approximately 10-13 feet below sea level. The marl ridge extends from near Everglades City southward to Cape Sable. As the continuous marl ridge formed, discharge through the Cape Sable area was blocked

shifting north through the Shark and Harney River systems (Wanless and Vlaswinkel, 2005). The approximate location of the marl ridge within the Cape Sable study area is shown on Figure 1.5.

Lake Ingraham appears to have been formed through impoundment between the marl ridge and an outer beach ridge, and possibly as a result of an oscillation in sea level that occurred approximately 1,200 years ago. Shoreline erosion has since created the scalloped cape shoreline of today.

As a result of the marl ridge, the interior of Cape Sable transformed into a mixture of isolated low supratidal to shallow subtidal carbonate mud flats followed by the formation of brackish to freshwater marshes in the lower areas. As sea level gradually rose, these marshes eventually spread resulting in the vast interior marsh we see today. The marl ridge partially acts as a boundary between the intertidal zone and the predominantly freshwater interior. During tides over 4 feet mean sea level (MSL), the marl ridge is overtopped and tidal waters flow into the interior (Crisfield et al., 2005).

Throughout the park, marl, peat, sand, and rock outcroppings are the four most common soils and substrate types. Marls are the most widespread soil type within the park and are mixtures of calcium-bearing fine sediments with calcite particles, sand, and/or shell fragments. These soils were formed in shallow waters with a relatively short period of flooding and, therefore, have high rates of microbial activity and decomposition of organic matter.

Peat is formed under anaerobic conditions during long periods of flooding, where the volume of decaying plant material exceeds the ability of microbes to decompose it. Peat deposits lie beneath the surface soils across the low-lying reaches of the park. Peat soils are identified by major vegetation categories of sawgrass and mangroves.

There are three basic Holocene sediment sequences in the Cape Sable area. The first comprises approximately half of Cape Sable from the southern portion of Cape Sable and the western portion up to Big Sable Creek. This sequence is dominated by calcium carbonate mud (marl) overlain by a few feet of organic peat. The second sequence is located in the landward and northern portions of Cape Sable and comprised entirely of organic peat. The third sequence dominates the western coast and capes comprised of calcareous shelly sand (Wanless and Vlaswinkel, 2005).

Within the existing Homestead canal dam area, the soils consist of approximately 13 feet of marl followed by a peat layer less than one foot thick. Below the peat is a layer of limestone, at least two feet thick. In the East Cape Extension canal dam area, the soils consist of approximately 14 feet of marl followed by a peat layer less than one foot thick. Below the peat layer is a layer of limestone, at least 3.5 feet thick.

The freshwater ecosystems of Cape Sable have experienced substantial change from exposure to the sea as a result of the construction of a network of canals dredged through the marl ridge to drain the cape's interior marshes for use in agriculture and cattle grazing in the early 20th century. The intrusion of saltwater into formally freshwater marsh systems has lead to the physical collapse of these marshes. Peat soil is lost and freshwater marsh communities are being replaced by open water saline communities. The constant movement of water (tidal flushing) has also led to the widening of several of the canals including the East Cape Extension and the Homestead canals.

The expansion of these canals has exacerbated sediment deposition in the cape's open waters and is converting Lake Ingraham into a tidal mud flat. Very little sediment from Florida Bay flows into East Cape canal on an incoming tide. Sediment peaks of 250-500 mg/l typically appear towards the end of ebbing tides. Today, the flood tidal delta in Lake Ingraham forms a sediment

body over 2.5 miles in length by approximately 0.5-1 mile in width and is 2-3 feet thick resembling an emergent system at low tide as a result of accumulation rates ranging from 3 to 14 cm/year (1.2 to 12.5 inches/year) measured *in situ* (Wanless and Vlaswinkel, 2005).

In addition, substantial erosion of soils has also occurred around the edges of the existing failed sheetpile dams at the East Cape Extension and Homestead canals potentially due to strong current, motorized boat wake, and/or vandalism. These openings at the failed dams continue to widen, due to erosional processes and transport marine waters eastward along the Homestead Canal as far as Bear Lake.

Many sediment peaks coincide with slack high tide. However, peaks also appear at slack low tide and every so often at times of highest (ebb or flood) velocities. Higher salinity in the interior marshes has altered vegetation patterns, reduced the quality of wildlife habitat, and lowered the productivity of forage fishes, potentially impacting the survival of various wading birds.

3.3.2 Environmental Consequences

3.3.2.1 Guiding Regulations and Policies

NPS *Management Policies 2006* (Section 4.8) states that the NPS would protect geologic features from the unacceptable impacts of human activity, while allowing natural processes to continue. The term “geologic features” describes the products and physical components of geologic processes. Examples of geologic features include rocks, soils, and minerals; geysers and hot springs in geothermal systems; cave and karst systems; canyons and arches in erosional landscapes; sand dunes, moraines, and terraces in depositional landscapes; dramatic or unusual rock outcrops and formations; and paleontological and paleoecological resources such as fossilized plants or animals, or their traces.

3.3.2.2 Assumptions, Methodology and Impact Thresholds

Potential impacts to soils are assessed based on the extent of disturbance to natural undisturbed soils, the potential for soil erosion resulting from disturbance, and limitations associated with the soils. Analysis of possible impacts to soil resources was based on on-site inspection of the resource within the project area, review of existing literature and maps, and information provided by the NPS and other agencies.

The following thresholds were used to determine the magnitude of impacts on soils and geologic features:

Negligible: Soils and geologic features would not be affected, or effects would not be measurable. Any soil erosion, effects on soil productivity, or the ability of the soil to support native vegetation would be slight, and would occur in a relatively small area.

Minor: Effects on soils or geologic features (soil erosion, effects on soil productivity or the ability of the soil to support native vegetation) would be detectable, but only a small area would be affected. If mitigation was needed to compensate for adverse effects, it would be relatively simple to implement and would likely be successful.

Moderate: Effects on soils or geologic features (soil erosion, effects on soil productivity or the ability of the soil to support native vegetation) would be readily apparent, and would occur over a relatively large area. Mitigation would probably be necessary to compensate for adverse effects and would likely be successful.

Major: Effects on soils or geologic features (soil erosion, effects on soil productivity or the ability of the soil to support native vegetation) would be readily apparent, and would substantially

change the soil or geologic characteristics over a large area. Extensive mitigation would be needed to compensate for adverse effects, and its success would not be assured.

Duration: Short-term impacts occur during all or part of alternative implementation; long-term impacts extend beyond implementation of the alternative.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to the existing failed dams along the marl ridge that would be directly affected by the proposed actions; however, impacts to soils in the expanded area of analysis in the greater Cape Sable area originating at the dam sites are also discussed.

3.3.2.3 Impacts of the Alternatives

Alternative A (No-Action)

1) Analysis. Under Alternative A, the current sheetpile dams at the East Cape Extension and Homestead canals would remain unchanged. As a result, soils within and adjacent to these areas would not be disturbed or compacted. However, due to the existing failed sheetpile dams, soils in the already eroded locations would have a greater potential for erosion during high tides and high water events.

Taking no action to address the issues associated with the dams on the East Cape Extension and Homestead canals would prolong the impacts of the current erosional processes in the canals. These processes would continue to act at current or potentially increasing rates. In the event of a hurricane or severe storm, there is a high probability that substantial further erosion of the marl banks would occur at the dam sites in addition to the erosional damage that currently exists today (Crisfield *et al.* 2005). Associated channel widening would also be expected to continue. These erosional processes would continue to cause a loss of peat soil from the interior marshes of and continued sediment deposition in the Cape's open waters, such as Lake Ingraham.

The adverse impacts to soils resulting from the actions proposed under this alternative would be long-term and moderate to major as effects on soils (soil erosion, effects on soil productivity or the ability of the soil to support native vegetation, and loss of sediment to Lake Ingraham) would be readily apparent and would substantially change the soil or geologic characteristics over a potentially large area due to expected continued erosion of the canal banks and associated sedimentation in Cape Sable's open waters. Extensive mitigation would be needed to compensate for adverse effects and its success may not be assured.

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). Geology, topography, and soils would be impacted by the increasing amount and duration of saltwater flow into the interior freshwater and brackish marshes of Cape Sable.

2) Cumulative Impacts. No cumulative impacts to geology, topography, and soils 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 geology, topography, and soils 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, respectively.

3) Conclusion. No beneficial effects to geologic or topographic conditions are anticipated as a result of Alternative A. Long-term moderate to major adverse impacts to soils and long-term negligible adverse impacts to geology and topography would result from the implementation of this project alternative. Consequently, there would be no impairment of soils, geology, or topography as a result of Alternative A.

Action Alternative C (Repair in Place)

1) Analysis. Under Alternative C, the existing sheetpile dams at the East Cape Extension and Homestead canals would be repaired and extended further inland. Additional sheetpile would be placed, as well as earthen fill and rip-rap for stabilization and armoring. Once completed, fill material would be placed to substantially increase the lateral support for the wall. Graded rip-rap would be placed on top of the fill material and along the deflector wingwall edges to provide erosion resistance. Under this alternative, new construction would be limited to filling the eroded areas, and placing new sheetpile and rip-rap. In the vicinity of the wingwalls on either end of the dam, minor leveling, grading, and excavation would be required before placing the rip-rap, resulting in long-term negligible adverse impacts to the geologic and topographic conditions of the site. Woody vegetation/debris clearing would be performed along the banks for equipment access and to provide a safe work zone. In areas where construction is proposed, heavy machinery would be used to install the sheetpile. As a result, soils within and adjacent to these sites would likely be disturbed and compacted resulting in short-term moderate adverse impacts to the soils at the site. Compacted soils, in addition to the rip-rap, reduce root growth and the ability for rainfall to infiltrate the soil, which would increase runoff. Compacted soils would inhibit seed germination and plant growth, which, over the long-term, decreases the amount of organic material within the soils and decreases overall soil productivity. To minimize the damage to soils, all Best Management Practices (BMPs) would be implemented during construction. The use of vehicles would be limited to times when the areas are not too wet and able to support the weight of the vehicles. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted, etc.) and replanted with native coastal wetland vegetation, where necessary. Therefore, long-term adverse impacts to soils within the work area are not expected to occur outside of the immediate footprint of the dams.

Due to the space limitations in the work area at both dam sites, a designated work zone has 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 Extension canal just south of the work zone and along the Homestead canal just west of the work zone.

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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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). This dredging activity would result in short-term, moderate to major, adverse impacts to existing soils, geology and topography within the dredging impact footprint of Lake Ingraham.

Turbidity/suspended soil resulting from the dredging operation, as well as the work within both canals, 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.). Therefore, negligible to minor adverse impacts beyond the construction footprint would occur as a result of turbidity/suspended soils. The turbidity barriers would be removed at the work areas in the canals once turbidity has subsided following construction completion of the dams. 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. 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 the temporary moderate to major adverse impacts to soils, geology and topography.

Thus, for the East Cape Extension canal, turbidity/suspended soils would result in short-term minor to moderate adverse impacts to soils, geology and topography within the canal work zone with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology and topography as a result of turbidity/suspended soils for the East Cape Extension canal. For the Homestead canal, turbidity/suspended soils would result in short-term moderate to major adverse impacts to soils, geology and topography within the impact footprint with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology and topography as a result of turbidity/suspended soils for the Homestead canal.

The resulting restored dams would decrease the velocity of currents dramatically during tidal flows, thus reducing erosional processes along the banks of the East Cape Extension and Homestead canals. Thus, erosion and channel widening would be expected to decrease, consequently reducing sediment deposition in the interior marshes and Lake Ingraham, providing a benefit to these systems. Therefore, long-term beneficial impacts to soils, geology and topography of the remaining portions of the East Cape Extension and Homestead canal systems would result.

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). Geology, topography, and soils 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 geology, topography, and soils 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 geology, topography, and soils 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 respectively.

3) Conclusion. Repairing the dam in place in the East Cape Extension and Homestead canals would not result in any long-term adverse impacts to the soils, geology and topographic conditions of the sites. However, for the East Cape Extension canal, short-term minor to moderate adverse impacts to soils, geology and topography within the canal work zone would occur from turbidity/suspended soils. For the Homestead canal, short-term moderate to major adverse impacts to soils, geology and topography within the impact footprint would occur from dredging and turbidity/suspended soils. For both projects, short-term negligible to minor adverse impacts to soils, geology and topography from turbidity/suspended soils would occur beyond the direct impact footprint (outside of the turbidity barriers). Short-term moderate adverse impacts at the dam sites are also expected to occur due to soil compaction in the work zones. Furthermore, long-term beneficial effects would occur from the resulting reduction of erosional processes along the banks of both canals. Consequently, there would not be an impairment of geology, topography or soils 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 approximate 100-foot plugs centered on the highest elevation point of the marl ridge along the East Cape Extension and Homestead canals (see Figures 2.3 and 2.4 in Section 2.1.1 depicting the location of the preferred alternatives along the highest elevation points of the marl ridge for each of the canals). Under Alternative D or G, new construction would consist of driving sheetpile across the canal in two locations, filling the canal between the two sheetpile structures, placing sheetpile as wingwalls, and placing rip-rap for armoring. Once completed, the plug would be planted with native vegetation to reduce the potential for erosion. Rip-rap would also be placed on the waterward side of both ends of the plugs to provide erosion resistance. In the vicinity of the wingwalls on either end of the dams, minor leveling, grading, and excavation would be required before placing the rip-rap, resulting in long-term negligible adverse impacts to the geologic or topographic conditions of the site. Woody vegetation/debris clearing of existing surface of substrate would be performed along the banks for equipment access and to provide a safe work zone. Sheetpile driving and canal filling (plug) operations would include using heavy machinery, which would result in soils being disturbed and compacted within and adjacent to these areas. This would pose short-term minor adverse impacts to the soils at the site. Compacted soils in addition to the rip-rap reduce root growth and the ability for rainfall to infiltrate the soil, which would increase runoff. Compacted soils would

inhibit seed germination and plant growth, which, over the long-term, decreases the amount of organic material within the soils and decreases overall soil productivity. To minimize the damage to the soils, all BMPs would be implemented during construction. The use of vehicles would be limited to times when the areas are not too wet and able to support the weight of the vehicles. 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. Therefore, long-term adverse impacts to soils within the work area are not expected to occur outside of the immediate footprint of the dams.

For the Homestead canal, these two alternatives would also require dredging of approximately 40,000 cubic yards of material from Lake Ingraham for access to the work area. Dredged material would be temporarily stockpiled adjacent to the access channel. However, the channel would be backfilled with the same material upon completion of construction (see Alternative C for additional dredging details). This dredging activity would result in short-term, moderate to major, adverse impacts to existing soils, geology and topography within the dredging impact footprint of Lake Ingraham.

Also, 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 Chapter 2 of this document for further details). This activity would result in the temporary disruption of soils within an area of approximately 0.025 acres. To minimize the damage to the soils, filling/grading activities would occur from a barge staged in the canal and all BMPs would be implemented during construction. 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. Thus, this filling activity would result in short-term, minor adverse impacts to existing soils and long-term beneficial effects to soils, geology and topography as a result of preventing a potential breach in the bank of the canal.

As mentioned in the analysis for Action Alternative C (above), turbidity/suspended soils would be contained within the construction footprint (both canal work areas and the Homestead canal access channel) for Alternatives D and G 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, 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.). Thus, for the East Cape Extension canal, turbidity/suspended soils would result in short-term minor to moderate adverse impacts to soils, geology and topography within the canal work zone with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology and topography as a result of turbidity/suspended soils for the East Cape Extension canal. For the Homestead canal, turbidity/suspended soils would result in short-term moderate to major adverse impacts to soils, geology and topography within the impact footprint with a potential for

short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology and topography as a result of turbidity/suspended soils for the Homestead canal.

The resulting restored dams would decrease the velocity of currents dramatically during tidal flows, thus reducing erosional processes along the banks of the East Cape Extension and Homestead canals. Thus, erosion and channel widening would be expected to decrease, consequently reducing sediment deposition in the interior marshes and Lake Ingraham, providing a benefit to these systems. Therefore, long-term beneficial impacts to soils, geology and topography of the remaining portions of the East Cape Extension and Homestead canal systems would result. Erosional damage from water overtopping the plugs would also be minimal due to the presence of rooted vegetation (planted) along the top of the plugs between the sheetpile walls and dissipation of energy over the length of the plugs (with Alternative G being longer, dissipation of water energy would be expected to be greater).

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). Geology, topography, and soils 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 geology, topography, and soils 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 geology, topography, and soils 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, respectively.

3) Conclusion. These two alternatives would not result in any long-term adverse impacts to the soils, geology and topographic conditions of the sites. However, for the East Cape Extension canal, short-term minor to moderate adverse impacts to soils, geology and topography within the canal work zone would occur from turbidity/suspended soils. For the Homestead canal, short-term moderate to major adverse impacts to soils, geology and topography within the impact footprint would occur from dredging and turbidity/suspended soils. For both projects, short-term negligible to minor adverse impacts to soils, geology and topography from turbidity/suspended soils would occur beyond the direct impact footprint (outside of the turbidity barriers). Short-term moderate adverse impacts at the dam sites are also expected to occur due to soil compaction in the work zones. Furthermore, long-term beneficial effects would occur from the resulting reduction of erosional processes along the banks of both canals. Consequently, there would not be an impairment of geology, topography or soils as a result of the implementation of Alternatives D and G.

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

1) Analysis. Alternative D1 and Alternative G1 are modifications of Alternatives D and G respectively, and involve installation using geotubes in place of sheetpile walls in the Homestead canal (only). One of the main advantages of this alternative for the Homestead canal dam site would be that dredging of Lake Ingraham and the western portion of the Homestead canal for access would not be required. However, 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 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). 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 anchored to the northern edge of the existing channel in Lake Ingraham and the eastern edge of the approach channel to the Homestead canal. Since the pipeline would be floating on top of the lake waters within the temporary impact area of the dredged channel, negligible impacts to the substrate of the lake are anticipated to occur from this activity. The six to eight inch pipeline would be constructed using a shallow draft barge and would extend from the work area (dam site) 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 to install the pipeline 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 Chapter 2 for further details regarding these alternatives). 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 Florida Bay originating from a designated staging area in the Florida Keys due to a lack of a suitable staging area in Everglades National Park. 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.). This alternative does not involve leveling or excavation in the vicinity of the dam. However, woody vegetation /debris clearing would be performed along the banks for equipment access and to provide for a safe work zone.

Canal filling (plug) between the geotubes would include using heavy machinery, which would result in soils being disturbed and compacted within and adjacent to these areas. This would pose short-term minor adverse impacts to the soils at the site. Compacted soils reduce root growth and the ability for rainfall to infiltrate the soil, which would increase runoff. Compacted soils would also inhibit seed germination and plant growth, which, over the long-term, decreases the amount of organic material within the soils and decreases overall soil productivity. To minimize the damage to the soils, all BMPs would be implemented during construction. The use of vehicles would be limited to times when the areas are not too wet and able to support the weight of the vehicles. 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. Therefore, long-term adverse impacts to soils within the work area are not expected to occur outside of the immediate footprint of the dam.

As mentioned in the analysis for Alternatives D and G, above, 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) with implementation of either of these modified alternatives (Alternatives D1 and G1). Since canal access would be limited for Alternatives D1 and G1, a helicopter would be used to import suitable fill material from an offsite staging area (to be chosen by the awarded contractor). The material would be dropped within the limits of the area to be filled and graded using small equipment and manual labor. Prior to filling, all BMP's would be employed to avoid impacts to adjacent wetlands. 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. Thus, this filling activity would result in short-term, minor adverse impacts to existing soils and long-term beneficial effects to soils, geology and topography as a result of preventing a potential breach in the bank of the canal.

As mentioned in the analysis for Action Alternative C (above), turbidity/suspended soil resulting from the work within the Homestead canal 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, 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.). Thus, turbidity/suspended soils would result in short-term minor to moderate adverse impacts to soils, geology and topography within the Homestead canal work zone with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology and topography as a result of turbidity/suspended soils for the Homestead canal.

The resulting restored dam would decrease the velocity of currents dramatically during tidal flows, thus reducing erosional processes along the banks of the Homestead canal. Thus, erosion and channel widening would be expected to decrease, consequently reducing sediment deposition in the interior marshes and Lake Ingraham, providing a benefit to these systems. Therefore, long-term beneficial impacts to soils, geology and topography of the remaining portions of the Homestead canal system would result. Additionally, the potential for erosion is further minimized due to the length of the plug (Alternative G1 would provide superior protection due to the longer plug in comparison to Alternative D1). Furthermore, the proposed location of the plug, centered at the highest elevation in the study area along the Homestead canal would serve as a natural hydrologic barrier further reducing natural erosional processes that have been exacerbated with the existing failed dam. Erosional damage from water overtopping the plug would also be minimal due to the presence of rooted vegetation (planted) along the top of the plug between the geotubes and dissipation of energy over the length of the plug (with Alternative G1 being longer, dissipation of water energy would be expected to be greater).

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). Geology, topography, and soils 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 geology, topography, and soils 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 geology, topography, and soils 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, respectively

3) Conclusion. These two modified alternatives would not result in any long-term adverse impacts to the soils, geology and topographic conditions of the site along the Homestead canal. However, short-term minor to moderate adverse impacts to soils, geology and topography within the canal work zone would occur from turbidity/suspended soils and short-term negligible to minor adverse impacts to soils, geology and topography from turbidity/suspended soils would occur beyond the direct impact footprint (outside of the turbidity barriers). Short-term moderate adverse impacts at the dam site are also expected to occur due to soil compaction in the work zones. Furthermore, long-term beneficial effects would occur from the resulting reduction of erosional processes along the bank of the Homestead canal. Consequently, there would not be an impairment of geology, topography or soils as a result of the implementation of Alternative D1 or Alternative G1.

3.4 Water Resources

3.4.1 Affected Environment

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). Surface waters located within the Cape Sable study area include several manmade canals, natural tidal creeks and Lake Ingraham. Given the surface elevation at Cape Sable and the nature of the Everglades hydrology, these surface waters are intrinsically connected to groundwater, which lies in unconfined aquifers just below the surface. Water availability in the park is very seasonal, which creates an interplay between the surface and groundwater. During the summer rainy season, increased precipitation recharges aquifers near the surface, while during drier winter months, the near surface aquifers provide water to the surface water bodies (NPS 2006).

3.4.1.1 Hydrology

The hydrologic system of the Cape Sable region is multifaceted, encompassing marine, intertidal, estuarine and freshwater sub-systems. In addition to the different hydrologic systems, the area is subject to tropical storms, periodic hurricanes and sea level rise. 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 Eastside creeks. Saltwater also enters the interior of Cape Sable through Whitewater Bay. In addition, during very high tides, the marl ridge is overtopped and substantial amounts of saltwater from the Gulf of Mexico enter the Cape Sable area.

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. Prior to excavation, seawater entered the interior wetlands only as high tide sheet flow. The East Cape canal allowed tidal flow behind the marl ridge and provided an additional tidal pathway into Lake Ingraham. Lateral erosion of the East Cape canal followed excavation and continued at a rate of about two feet per year. Earthen plugs were installed in the late 1950's or early 1960's to reduce the strong tidal flow and halt widening of the canal. Today, the inlet area of the East Cape canal is approximately 220 feet wide, and this width extends from the coast to Lake Ingraham. In 1997, the original plug was replaced with sheet piling driven into the bed and banks of the canal, but immediately after installation, the right bank of the sheet piling failed providing a conduit for the tidal flow. Because the area of the breach is so much smaller than the canal cross sectional area, velocities increase dramatically through the breach during tidal flux (Crisfield *et al,* 2005).

Homestead Canal, like the other interior canals was constructed in the 1920's. The canal cuts across the marl ridge in a low area and continues eastward for a short distance entering Lake Ingraham on its northeast shore. An earthen canal plug was constructed in the late 1950's or early 1960's which reduced the strong tidal flow thus halting any widening of the canal. In the 1990's the original plugs in Homestead and East Cape Canals were replaced with sheet piling driven into the bed and banks of the watercourses. Sometime soon after installation, the left bank adjacent to the sheet piling failed in both canals reopening the interior wetlands to tidal flow. Because the area of the breaches is so much smaller than the canal cross sectional area, velocities increase dramatically through the breach during tidal flux. The two failed sheet piling structures create dangerous hydraulic conditions during tidal flux to non-motorized boats and an underwater hazard during high tide to motorized boats (Crisfield *et al,* 2005). Also, the results of the DTM survey (conducted in March 2009) 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 prevent the potential for short-circuiting the proposed restoration alternatives. These filling activities along the Homestead canal would be required for all of the proposed action alternatives, with the exception of 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 (see Section 2.1.1. of this document for further details regarding the DTM survey).

The Cape Sable canals drain freshwater from the interior wetlands and permit salt water from the Gulf of Mexico to penetrate inland. This salt water intrusion is accelerating the change from freshwater wetlands to a marine ecosystem. Because the landscape no longer retains freshwater, rapid drainage through the canals accelerate acute impacts, such as marsh collapse. Higher salinity in interior marshes reduce juvenile crocodile habitat suitability and lower the productivity of forage fishes; thereby, potentially affecting the ability for wading birds and other fauna to forage efficiently. Water flow is an important component of the Everglades

ecosystem; thus, surface water flow has been extensively monitored within Everglades National Park.

The incursion of saltwater into formally freshwater marsh systems as the result of sea level rise has lead to physical collapse of these marshes. Peat soil is lost and freshwater marsh communities are being replaced by open water saline communities. This process has been accelerated on Cape Sable by saltwater moving through the East Cape Extension and Homestead 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.

3.4.1.2 Water Quality

Waters in the park are designated Outstanding Florida Waters (OFW) and, therefore, no degradation of surface water quality is permitted. An OFW is a waterbody designated worthy of special protection because of its natural attributes, and the designation is intended to protect existing good water quality (Florida DEP 2007a). Because surface waters of the Cape Sable area are of high quality, they are particularly susceptible to degradation. Typically, within an area designated as an OFW, onshore or in-water activities with the potential to create turbidity are restricted to maintain conditions within zero Nephelometric Turbidity Units (NTU) above ambient conditions. Surface waters located within the Cape Sable study area include several natural tidal creeks and Lake Ingraham.

A substantial quantity of saltwater from Florida Bay and the Gulf of Mexico enters the Cape Sable region through a series of manmade canals, such as the East Cape Extension and Homestead canals. The intrusion of tidal saltwater and loss of freshwater is accelerating the degradation of the interior freshwater and brackish marshes of Cape Sable. The National Audubon Society recorded daily mean salinity data from October 2001 to February 2006 at Bear Lake in Everglades National Park to determine the extent of tidal saltwater intrusion and freshwater loss in the interior freshwater and brackish marshes. The western edge of Bear Lake is located approximately six miles northeast of the existing East Cape Extension canal dam and approximately 7.5 miles east of the existing Homestead canal dam, and is directly connected to the Homestead canal east of where it connects to the East Cape Extension canal (Figure 3.1). Salinity data from Bear Lake show a salinity range of 4.86 parts per thousand (ppt) to 10.20 ppt (in the range of moderately saline or brackish water) in the partial year data from 2001. The range of salinity readings for 2002 through 2006 showed a marked increase in both the minimum and maximum recorded daily mean salinity, as shown in Figure 3.2. The complete year of data from 2002 showed a minimum recorded daily mean salinity of 4.96 ppt and a maximum of 16.33 ppt, and increase from the previous year. The upward trend in salinity increased through 2003 (9.02 ppt to 20.28 ppt), 2004 (18.89 ppt to 36.11 ppt), and 2005 (15.46 ppt to 40.86), all in the range of highly saline water. The partial year of data from 2006 ranged from 33.90 ppt to 36.36 ppt, essentially equivalent to the salinity of tidal saltwater, showing the substantial influx of saltwater and loss of freshwater in the interior marshes in recent years.

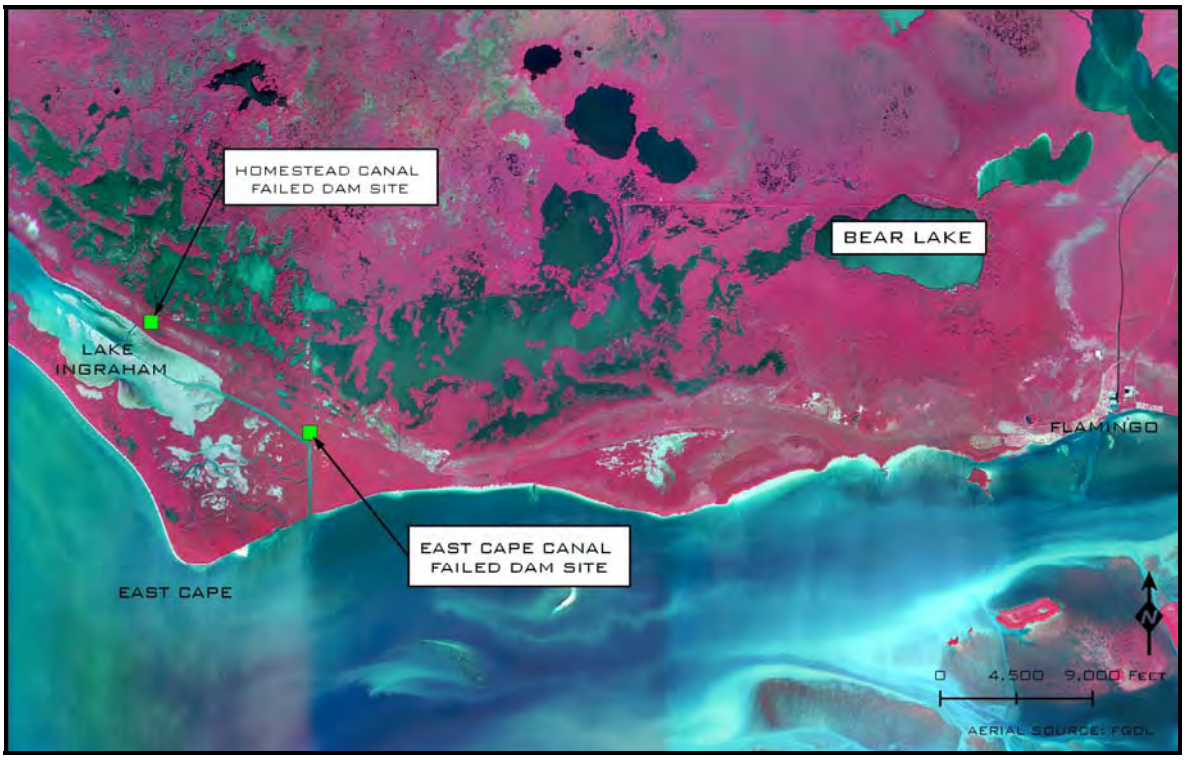


Figure 3.1 – Location of Bear Lake Salinity Monitoring Station in Proximity to the East Cape Extension and Homestead Canal Dams

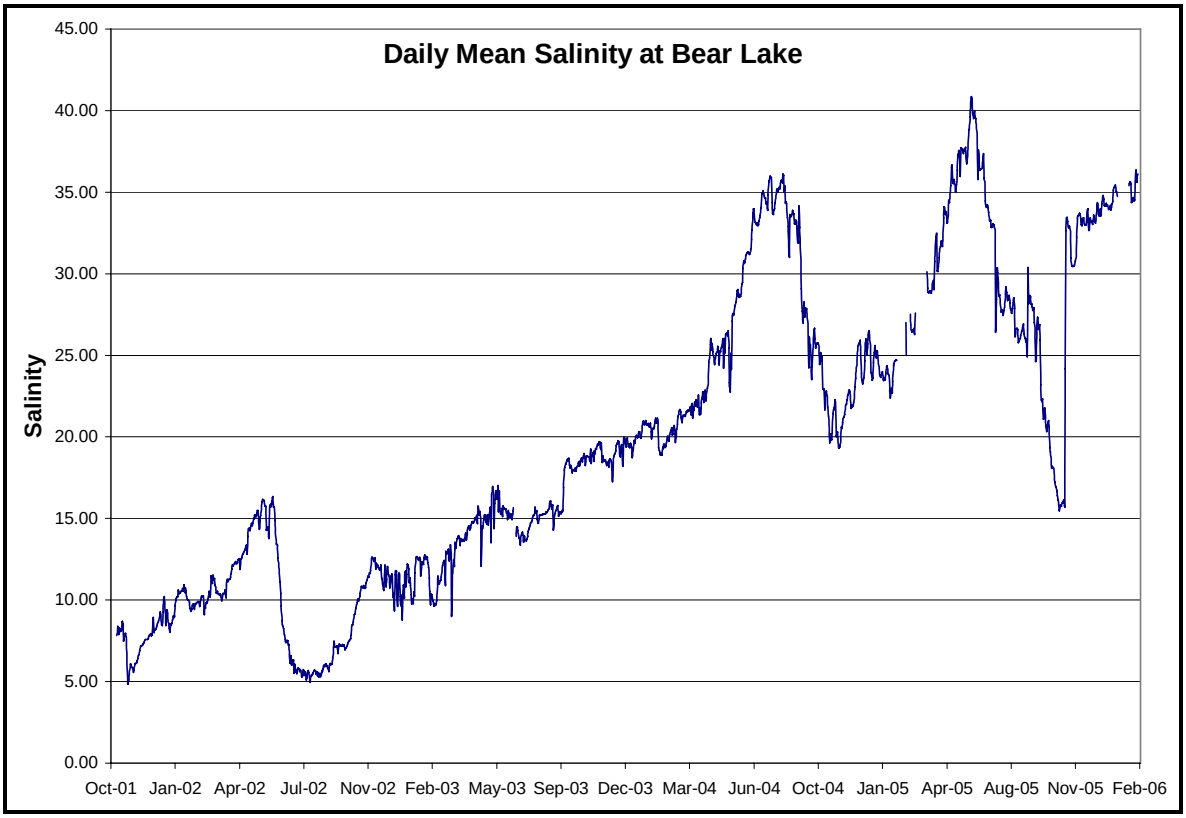


Figure 3.2 – Daily Mean Salinity at Bear Lake (2001 to 2006)

According to Wanless and Vlaswinkel (2005), large amounts of sediment are being deposited in Lake Ingraham through the canals. The results of their study showed that approximately 12% of the sediment transported into Lake Ingraham by daily tidal currents is stored within the lake. This deposition of sediments is virtually converting Lake Ingraham into a mud flat.

Water quality monitoring data for certain parameters are available for the western portion of Florida Bay and Whitewater Bay as a part of the Southeast Environmental Research Center (SERC) water quality monitoring network, which was established to address regional water quality concerns. This monitoring program, which is managed out of Florida International University (FIU), was initiated in response to public perception that the Everglades ecosystem is in danger. In the case of Florida Bay, the major impetus was the combination of seagrass die-off, increased phytoplankton abundance, sponge mortality, and a perceived decline in fisheries beginning in 1987. In response to these issues, a network of water quality monitoring stations was established in 1989 (see Figure 3.3).

Several stations are located in Florida Bay and in the Whitewater Bay areas that would be accessed by boats. All Florida Bay stations are sampled monthly for nutrients (nitrogen and phosphorus), chlorophyll-a (an indicator of phytoplankton biomass), and various field parameters such as salinity, dissolved oxygen, temperature, and turbidity. Analyses of Florida Bay water quality have shown that the bay would be delineated into three groups of stations with similarities in water quality, or zones of similar influence. The Western Bay zone lies directly south of the Cape Sable area and is most influenced by the Gulf of Mexico tides (see Figure 3.4).

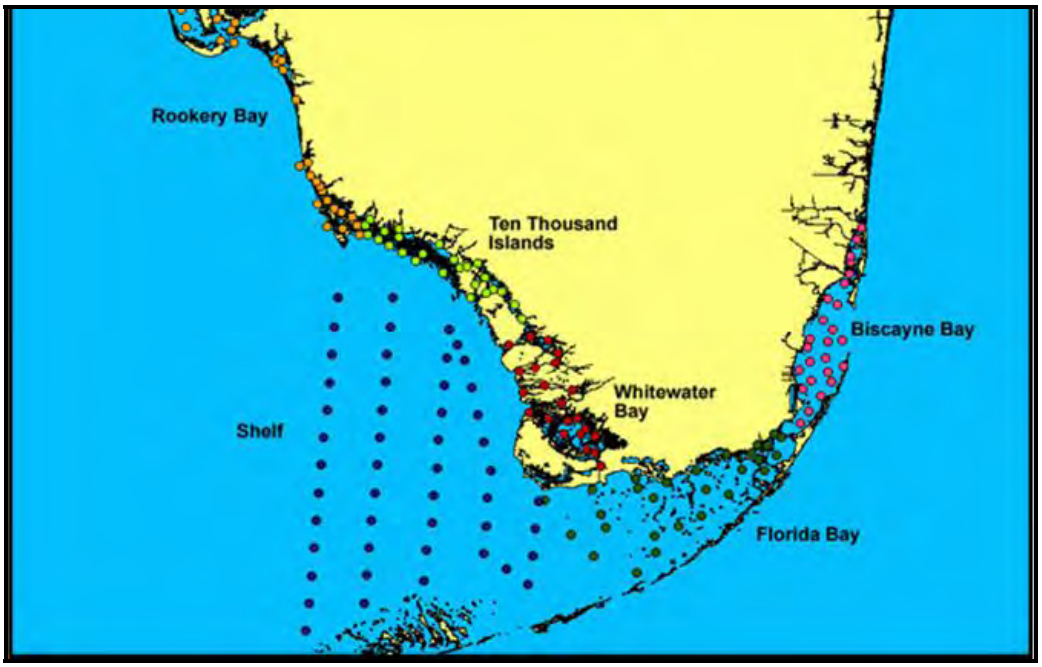


Figure 3.3 – Fixed station locations for the South Florida Coastal Water Quality Monitoring Network (Source: SERC 2005)

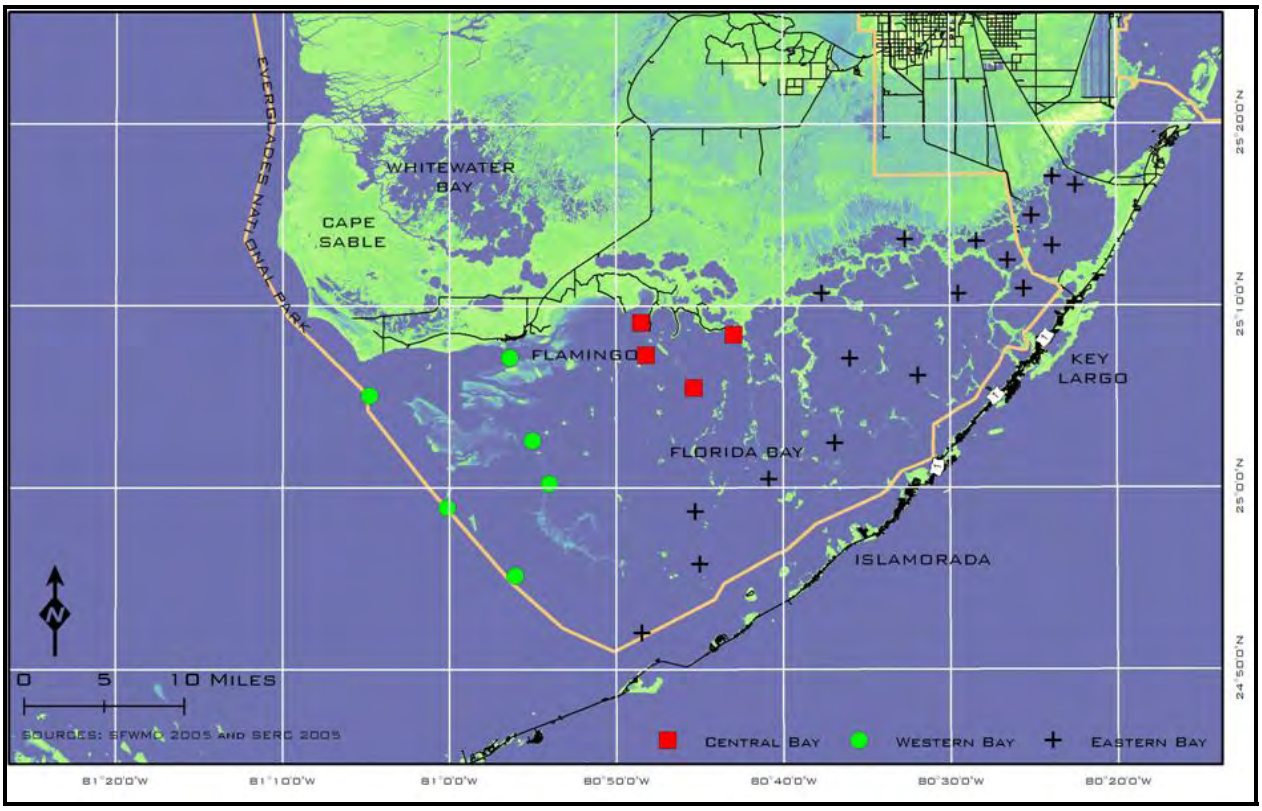


Figure 3.4 – Zones of Similar Water Quality in Florida Bay (Source: SERC 2005)

The SERC monitoring program has produced a series of reports, with annual summaries. According to the one of the latest comprehensive reports available (SERC 2005), turbidity (cloudiness) has increased dramatically in both the Western and Central areas since monitoring began in 1991. Regarding nutrients, total phosphorus concentrations have declined baywide over the 14 year period of record, although there have been recent substantial peaks during the fall in both the Eastern and Western Bay areas. The Western Bay is lowest in dissolved inorganic nitrogen of all three areas, and phytoplankton in the Western Bay may be more limited by nitrogen than by phosphorus. A 2003 report also notes that the algal blooms in the Western Bay are mainly limited by nitrogen, either singly or in combination with phosphorus and/or silica (Florida Bay Science Program, 2003). Whitewater Bay is a semi-enclosed body of water with a relatively long residence time, which receives overland freshwater flow from the Everglades marsh. The long residence time may explain the low phosphorus concentrations seen (due to biological uptake), while the high evaporation rate concentrates dissolved organic matter (SERC, 2005).

Concerns for water quality in the Cape Sable study area include increased turbidity from large storms, tides, currents, etc. through the East Cape Extension and Homestead canals and from human-induced affects vis-à-vis motorized boats. Besides the obvious effect from strong onshore winds and large storms on sediment distribution, as a result of the failed dams in the East Cape Extension and Homestead canals, strong currents via flood and ebb tides carry turbid water to Lake Ingraham and Florida Bay/Gulf of Mexico. Spring tides have a larger tidal range and therefore larger velocities; larger velocities result in higher suspended sediment concentrations and overall higher transports; however, the winter storms make up the largest contribution to the net sediment flux. (Wanless and Vlaswinkel, 2005).

The use of motorized boats within the Cape Sable study area also has the potential for an oil or gas release that may adversely impact water quality. Spill control kits are typically available from park personnel/marine patrol to address potential spill impacts, if they occur.

3.4.1.3 Vegetation and Wetlands

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, 2009). Figure 3.5 shows the wetland classification of 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. Florida Bay is classified as an estuarine subtidal habitat with aquatic beds of unknown substrate characteristics. Wetlands are extremely important habitats and support a wide variety of wildlife, as discussed in the sections on "Wildlife and Habitat" and "Special Status Species". As noted in the regulatory summary, NPS must protect wetlands from adverse impacts whenever possible (DO 77-1) and must minimize adverse effects if impacts cannot be avoided.

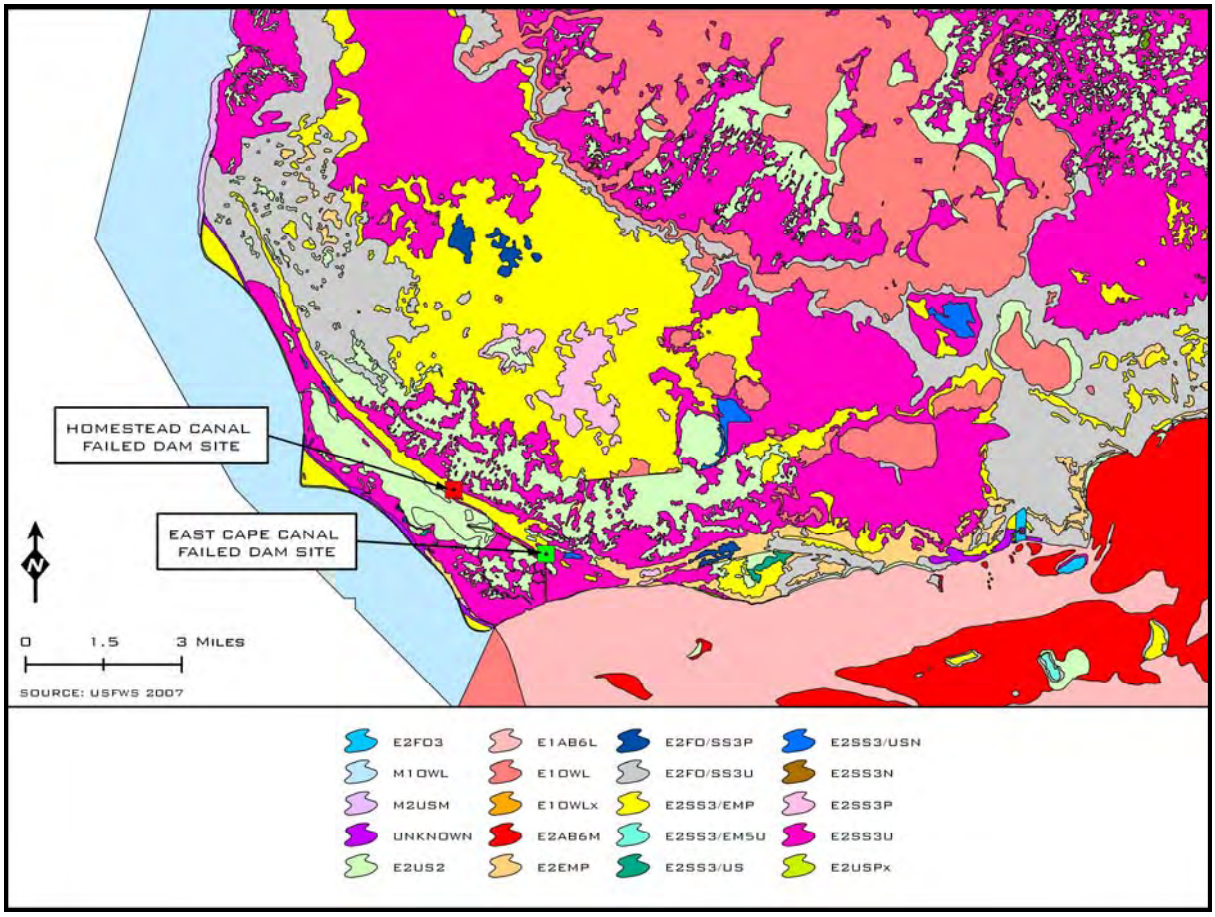


Figure 3.5 – National Wetland Inventory Map (Source: USFWS 2007)

Prior to canal construction, the interior of Cape Sable consisted predominantly of freshwater marsh intermixed with brackish marsh. The marl ridge (see Figure 1.5) 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.

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. These areas appear to be in the transition stage from a freshwater wetland to a saline wetland.

Peat soil is lost and freshwater 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:

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

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 (see Figure 3.6).

Figure 3.6 – Mangroves and Algal Mats Forming on the Higher Portions of the Delta in Lake Ingraham.

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 (*Borrichia 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 that 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.

Since the preferred alternative would result in adverse impacts to existing wetlands, a Statement of Findings (SOF) in accordance with procedures described in Procedural Manual 77-1: Wetland Protection, has been prepared (see Appendix A).

3.4.2 Environmental Consequences

3.4.2.1 Guiding Regulations and Policies

The primary regulations relevant to this section are the *Clean Water Act*. The objective of the *Clean Water Act* is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The act supports establishment and enforcement of water quality standards, which would be set by states with delegated authority. Florida has this authority, and has delegated all waters of Everglades National Park as OFWs. Section 403.061 (27), Florida Statutes, grants the Florida Department of Environmental Protection (FDEP) power to: "Establish rules which provide for a special category of water bodies within the state, to be referred as "Outstanding Florida Waters," which shall be worthy of special protection because of their natural attributes." The state has an anti-degradation standard for such waters. Florida's surface water standards are found in Section 62-302 of the Florida Administrative Code. These include the anti-degradation standard mentioned above as well as minimum criteria related to the presence of debris, oils, scum, color, odor, taste, and turbidity. Section 62-302.700 addresses the special protection afforded to OFWs. As described in the Purpose and Need chapter, two federal executive orders, EO 11990 (Protection of Wetlands) and EO 11988 (Floodplain Management) direct federal agencies to avoid adverse impacts to floodplains and wetlands. Director's Order #77-1 establishes policies, requirements, and standards for implementing Executive Order 11990, while Director's Order #77-2 applies to all NPS proposed actions, including the direct and indirect support of floodplain development that would adversely affect the natural resources and functions of floodplains, including coastal floodplains, or increase flood risks.

Director's Order #77-1 states the NPS would employ a sequence of avoiding adverse wetland impacts to the extent practicable, minimizing impacts that would not be avoided, and compensating for remaining unavoidable adverse wetland impacts by restoring degraded wetlands. If the preferred alternative would result in adverse impacts to wetlands, the NPS would prepare and approve a Statement of Findings (SOF) in accordance with procedures described in Procedural Manual 77-1: Wetland Protection. Since wetland resources are located within the study area and would be adversely affected by the construction of the proposed project, a SOF has been prepared in accordance with procedures described in Procedural Manual #77-1 (see Appendix A).

Director's Order #77-2 states that this procedure does not apply to certain park functions in "isolated backcountry sites, natural or undeveloped sites along trails or roads, survey and study

sites, or other similar activities" that are often located near water for the enjoyment of visitors but require little physical development and do not involve overnight occupation. Thus in accordance with procedures described in Procedural Manual #77-2: Floodplain Management, this project meets the criteria under Section V.B. *Excepted Actions*.

NPS *Management Policies 2006* specifically address water quality, wetlands, and floodplains in Sections 4.6.3, 4.6.4, and 4.6.5, respectively. The policies state that NPS would "take all necessary actions to maintain or restore the quality of surface waters and ground waters within parks consistent with the Clean Water Act and all other applicable and federal, state, and local laws and regulations" and provide similar protective provisions for wetlands and floodplains that reiterate the language in the Director's Orders discussed above (NPS 2006b).

3.4.2.2 Assumptions, Methodology and Intensity Thresholds

Information from the SERC water quality monitoring network, maps showing water resources (including NWI wetland maps, aerial photographs and FEMA floodplain maps) within the Cape Sable area, summaries from other studies completed in the area, site visits, and coordination with NPS staff were used to identify baseline conditions for the analysis. In general, it was assumed that there would be impacts to water resources that occur from the construction phase of the alternatives. The primary steps taken in assessing impacts on water resources included determining what the likely pollutants might be from construction activities and subsequent use of the area; and whether or not any planned use, construction, or associated pollutants would directly or indirectly affect water quality and/or wetlands over either a short or long term period, and over what area this would occur. Mitigation measures considered in this analysis are listed in Chapter 2 and are mentioned in the analysis where appropriate. The thresholds for the intensity of an impact are defined for the different water resources topics as follows:

3.4.2.2.1 Hydrology

Negligible: Hydrology would not be affected, or changes would be at low levels of detection. Any detected effects to hydrology would be slight and localized.

Minor: Changes in hydrology would be measurable, although the changes would be small and localized.

Moderate: Changes in hydrology would be measurable and regional.

Major: Changes in hydrology would be readily measurable, and would have observable consequences on a regional scale.

Duration: Short-term – Recovers in less than 1 year. Long-term - Takes more than 1 year to recover.

Analysis area: The area of analysis for hydrology is the expanded study area that includes Lake Ingraham, the East Cape Canal, the Homestead Canal and the freshwater and brackish interior marshes beyond the existing failed dams.

3.4.2.2.2 Water Quality

Negligible: Chemical, physical or biological effects would not be detectable, and parameters would be well below water quality standards or criteria for the designated use of the water and within historical or desired water quality conditions.

Minor: Chemical, physical or biological effects would be detectable, but parameters would be well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Chemical, physical or biological effects would be detectable, but parameters would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions may be altered on a limited time and space basis.

Major: Chemical, physical or biological effects would be detectable and would be frequently altered from the historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards or criteria may be exceeded.

Analysis area: The area of analysis for water quality is the expanded area of analysis that includes Lake Ingraham, the East Cape Canal, the Homestead Canal and the freshwater and brackish interior marshes beyond the existing failed dams.

3.4.2.2.3 Vegetation and Wetlands

The impact thresholds for wetlands are based on the wetlands acreage permanently filled or restored, and the size, integrity, and connectivity of the wetlands affected. These indicators are defined as follows:

- Size – The severity of impacts to wetlands depends on the size of the wetland impacted. A small area of impact in a large wetland would be likely to have less of an effect than a large area of impact in a small wetland. The change in size of a wetland, as a result of an impact, would also influence the integrity and connectivity of the wetland and vice versa.
- Integrity – Highly intact wetland areas with little prior disturbance would be more susceptible to impacts from direct development than a wetland previously degraded by development or other activities. The loss of function and productivity of the higher quality wetland would be a greater loss than that of a lower quality wetland. Additionally, indirect impacts due to human trampling or a change in vegetation or hydrology would also impact the integrity of the wetland.
- Connectivity – The relationship of wetlands to other wetlands or other valuable natural resources is also important in determining the degree of impact or project benefits. Narrow, previous trail corridors that are infrequently or seasonally used would have less fragmenting effect than would a wide hard-surface roadway with high volumes of vehicular or pedestrian traffic. Establishment of buildings or other structures in wetlands areas would also create barriers to the natural dispersal of plants and animals and impact the connectivity of wetlands.

Negligible: No measurable or perceptible effects on size, integrity or connectivity of wetlands would occur. No U.S. Army Corps of Engineers 404 permit would be necessary.

Minor: The effect on wetlands would be measurable or perceptible, but small in terms of area and the nature of the impact. A small effect on size, integrity, or connectivity would occur; however, the overall viability would not be affected. If left alone, an adversely affected wetland would recover, and the impact would be reversed. A U.S. Army Corps of Engineers 404 permit would not be required.

Moderate: The impact would be sufficient to cause a measurable effect on one of the three parameters (size, integrity, connectivity) or would result in a permanent loss or gain in wetland acreage, but not to large areas. Wetland functions would not be affected in the long-term. A U.S. Army Corps of Engineers 404 permit would be required.

Major: The impact would result in a measurable effect on all three parameters (size, integrity, connectivity) or a permanent loss or gain of large wetland areas. The impact would be substantial and highly noticeable. The character of the wetland would be changed so that the

functions typically provided by the wetland would be substantially altered. A U.S. Army Corps of Engineers 404 permit would be required.

Analysis area: The area of analysis for wetlands is the expanded study area, including wetlands in the greater Cape Sable area that would be affected by impacts originating at the East Cape Extension and Homestead canal dam sites.

3.4.2.3 Impacts of the Alternatives

3.4.2.3.1 Hydrology

Alternative A (No-Action)

1) Analysis. Under Alternative A, current conditions would continue and there would be no beneficial effects on the current hydrologic conditions within the project areas. However, taking no action to address the issues associated with the existing failed dams on the East Cape Extension and Homestead canals would sustain the anthropomorphic impacts on hydrologic processes in the Cape Sable area. These anthropomorphic impacts include the loss of the marl ridge function as a hydrologic barrier, continued flow of saline waters through canals and marsh collapse north of the ridge, continued erosion and widening of the canals, and persistence of dangerous hydraulic conditions at the dam sites.

Prior to canal excavation, seawater entered the interior wetlands only during extreme storm events. The excavated canals currently allow normal tidal flow behind the marl ridge severely reducing its function as a natural hydrologic barrier. Both canals effectively drain freshwater from the interior wetlands and permit salt water from the Gulf of Mexico to penetrate inland, accelerating the transition of the freshwater wetlands to a marine ecosystem and exacerbating marsh collapse via erosional processes. Related erosion and channel widening has substantially increased with the failure of the existing dams and would be expected to continue. In the event of a large magnitude hurricane, there is a high probability that the existing sheetpile dams may cause substantial erosion of the marl banks at the dam site in addition to the erosional damage that currently exists today (Crisfield *et al*, 2005). In addition, dangerous hydraulic conditions currently exist at both failed dam sites. Because the cross sectional area of the breaches are so much smaller than the canal cross sectional areas, water velocities increase dramatically through the breaches during tidal flux. The two failed sheet piling structures create dangerous hydraulic conditions during tidal flux to non-motorized boats and an underwater hazard during high tide to motorized boats (Crisfield *et al,* 2005).). All of these processes would continue to act at current or potentially increasing rates with Alternative A and would result in long-term moderate to major adverse impacts.

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). Hydrology 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 hydrology 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 hydrology 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, respectively

3) Conclusion. Alternative A would continue to exacerbate the adverse impacts to the ecosystems of the greater Cape Sable area caused by the excavation of these canals. No beneficial effects to hydrology are anticipated as a result of Alternative A. Alternative A would produce long-term moderate to major adverse impacts on hydrology. Consequently, there would be no impairment of hydrology as a result of Alternative A..

Action Alternative C (Repair in Place)

1) Analysis. This alternative proposes to repair the existing sheetpile dam on the East Cape Extension and Homestead canals by extending the existing wall through the canal banks further inland and placing earthen fill and riprap for stabilization and armoring. Implementation of Alternative C would result in a dramatic decrease in the quantity and velocity of water flow during tidal flows; thus, reducing erosional processes along the banks of the canal. The flow of saline waters over the marl ridge in the vicinity of the dam sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side creek), consequently reducing the rate of intrusion of saltwater into the interior marshes. In addition, the rate of erosion and channel widening would be expected to decrease within the limits of the East Cape Extension and Homestead canals, resulting in a reduction in sediment and organic material transport into Lake Ingraham and Florida Bay. The rehabilitated dams would allow for the marl ridge to regain its function as a natural hydrologic barrier at this location, and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Overtopping of the marl ridge with saline waters would still occur during high tide and major storm events. Thus, implementation of Alternative C would lead to long-term beneficial impacts on overall hydrologic flows in the area of the East Cape Extension and Homestead canals.

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). Hydrology 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 hydrology 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 hydrology 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, respectively.

3) Conclusion. This alternative would restore the local hydrologic regime to a more natural state. High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel formation. However, this process is considered a natural process and should not be viewed as an adverse impact.

According to the U.S. Geological Survey (USGS), the potential exists for the erosion of the soft marl sediments at either end of the dam structure, which may be hardened with rock, steel and/or concrete from the change in hydraulics of the canals. This occurrence may eventually lead to a compromise of the structure. Another hydraulic consideration is that any structure placed in the canal would be subjected to substantial hydraulic conditions over the course of time (rising tides, extreme tide wash-over and overland floods). Episodic and potentially extreme conditions occur with tropical storms and hurricanes. Thus, under a hurricane scenario, any structure placed in the canals has the possibility of failing (USGS 2005). Alternative C has been designed with consideration of these issues and is expected to withstand the elements, barring any major devastating storm events, for the next 50 years. However, Alternative C has a higher probably of being breach during a catastrophic event than Alternatives D and G since it's a considerably smaller dam structure than the earthen plugs proposed in alternatives D and G.

Alternative C would result in long-term beneficial impacts on hydrology in the study area. Consequently, there would be no impairment of park hydrology resources as a result of 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 dam would be removed and replaced with an approximate 100-foot plug centered on the highest elevation point of the marl ridge along the East Cape Extension and Homestead canals (see Figures 2.3 and 2.4 in Section 2.1.1 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 dam would be removed and replaced with a plug filling the length of the approximate marl ridge along the East Cape Extension (370') and Homestead (430') canals. The impacts during construction of either alternative are a direct result of the placement of the new sheetpile, earthen fill and riprap for the new plug, stabilization and armoring. Implementation of Alternatives D and G would result in a dramatic decrease in the quantity and velocity of water flow during tidal flows; thus, reducing erosional processes along the banks of the canal. The flow of saline waters over the marl ridge in the vicinity of the dam sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side creek), consequently reducing the rate of intrusion of saltwater into the interior marshes. In addition, the rate of erosion and channel widening would be expected to decrease within the limits of the East Cape Extension and Homestead canals, resulting in a reduction in sediment and organic material transport into Lake Ingraham and Florida Bay. The rehabilitated dams would allow for the marl ridge to regain its function as a natural hydrologic barrier at this location, and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Overtopping of the marl ridge with saline waters would still occur during high tide and major storm events. Thus, implementation of Alternatives D or G would lead to long-term beneficial effects on overall hydrologic flows in the area of the East Cape Extension and Homestead canals.

Also, 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 Chapter 2 of this document for further details). The resulting higher elevation would help to facilitate the restoration of the marl ridge as a natural hydrologic barrier at this location, as mentioned above. 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. Thus, this filling activity would result in long-term beneficial effects on hydrology 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). Hydrology 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 hydrology 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 hydrology 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, respectively.

3) Conclusion. These alternatives would restore the local hydrologic regime to a more natural state. High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel formation. However, this process is considered a natural process and should not be viewed as an adverse impact.

According to the USGS, the potential exists for the erosion of the soft marl sediments at either end of the dam structure, which may be hardened with rock, steel and/or concrete from the change in hydraulics of the canals. This occurrence may eventually lead to a compromise of the structure. Another hydraulic consideration is that any structure placed in the canals would be subjected to substantial hydraulic conditions over the course of time (rising tides, extreme tide wash-over and overland floods). Episodic and potentially extreme conditions occur with tropical storms and hurricanes. Thus, under a hurricane scenario, any structure placed in the canals has the possibility of failing (USGS 2005). However, Alternatives D and G have been designed with consideration of these issues and are expected to withstand the elements, barring any major devastating storm events, for the next 50 years.

Alternatives D and G would result in long-term beneficial impacts on hydrology in the study area. Consequently, there would be no impairment of park hydrology resources as a result of implementation of Alternatives D or G.

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

1) Analysis. Alternative D1 or Alternative G1 provide a construction option for the Homestead canal (only) that allows for further avoidance and minimization of impacts. Geotubes would be used in place of sheetpile allowing for the avoidance of dredging a 52-foot wide by approximately 8,320 feet long navigational channel through Lake Ingraham for accessing the work zone. 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. Under Alternative G1, the existing dam would be removed and replaced with a plug filling the length of the approximate marl ridge (430') along the Homestead canal. The impacts during construction of either alternative are a direct result of the placement of the geotubes, earthen fill, and riprap.

Implementation of Alternative D1 or Alternative G1 would result in a dramatic decrease in the quantity and velocity of water flow during tidal flows; thus, reducing erosional processes along the banks of the Homestead canal. The flow of saline waters over the marl ridge in the vicinity of the dam site would be restricted to the natural tidal cycles and any existing tidal creeks in the area, consequently reducing the rate of intrusion of saltwater into the interior marshes. In addition, the rate of erosion and channel widening would be expected to decrease within the limits of the Homestead canal, resulting in a reduction in sediment and organic material transport into Lake Ingraham and Florida Bay. The rehabilitated dam would allow for the marl ridge to regain its function as a natural hydrologic barrier at this location, and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Overtopping of the marl ridge with saline waters would still occur during high tide and major storm events. Thus, implementation of Alternative D1 or Alternative G1 would lead to long-term beneficial impacts on overall hydrologic flows in the area of the Homestead canal.

Also, as mentioned in the analysis for Alternatives D and G, above, 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) with implementation of either of these modified alternatives (Alternatives D1 and G1). Since canal access would be limited for Alternatives D1 and G1, a helicopter would be used to import suitable fill material from an offsite staging area (to be chosen by the awarded contractor). The material would be dropped within the limits of the area to be filled and graded using small equipment and manual labor. Prior to filling, all BMP's would be employed to avoid impacts to adjacent wetlands. The resulting higher elevation would help to facilitate the restoration of the marl ridge as a natural hydrologic barrier at this location, as mentioned above. 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. Thus, this filling activity would result in long-term beneficial effects on hydrology 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). Hydrology 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 hydrology 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 hydrology 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, respectively

3) Conclusion. These alternatives would restore the local hydrologic regime to a more natural state. High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel formation. However, this process is considered a natural process and should not be viewed as an adverse impact.

According to the USGS, the potential exists for the erosion of the soft marl sediments at either end of the dam structure, which may be hardened with rock, steel and/or concrete from the change in hydraulics of the canal. This occurrence may eventually lead to a compromise of the structure. Another hydraulic consideration is that any structure placed in the canal would be subjected to substantial hydraulic conditions over the course of time (rising tides, extreme tide wash-over and overland floods). Episodic and potentially extreme conditions occur with tropical storms and hurricanes. Thus, under a hurricane scenario, any structure placed in the canal has the possibility of failing (USGS 2005). However, Alternative D1 and Alternative G1 have been designed with consideration of these issues and are expected to withstand the elements, barring any major devastating storm events, for the next 50 years.

Alternative D1 and Alternative G1 would result in long-term beneficial impacts on hydrology in the study area. Consequently, there would be no impairment of park hydrology resources as a result of implementation of Alternative D1 or Alternative G1.

3.4.2.3.2 Water Quality

Alternative A (No-Action)

1) Analysis. Taking no action to address the issues associated with the dams at the East Cape Extension and Homestead canals would allow for the influx of tidal saltwater intrusion and loss of freshwater to continue, impacting the interior freshwater and brackish marshes of the greater Cape Sable area. These processes would continue to act at current or potentially increasing rates, adversely impacting wetlands and wildlife in the Cape Sable area (discussed in Sections 3.4.2.3.3 and 3.7.2.3). In addition to sediment deposition (discussed in Section 3.3.2.3), the resulting turbidity/suspended soils from erosional processes have the potential to cause short-term and long-term moderate to major adverse impacts on marine resources within and downstream of the study area (i.e., Florida Bay and the Gulf of Mexico) via reduced sunlight penetration (see Marine Resources section of EA for further information). Also, sediment erosion has the potential to increase nutrient loading in Lake Ingraham and subsequently, Florida Bay and the Gulf of Mexico. This increase in nutrients (e.g., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources. Furthermore, turbid waters would adversely affect the aesthetics of park water resources, which, in turn, has the potential to result in short-term and potentially long-term moderate adverse impacts in visitor usage of the area (reduction of the number of visitors utilizing the Cape Sable wilderness area due to reduced water quality). These resulting adverse effects would potentially continue or even increase with Alternative A, resulting in moderate to major adverse impacts.

Minor impacts on water quality under Alternative A would also result from the continued use of the interior wilderness area by motorized boaters. The use of fuels in motorized boats have the potential to create minimal releases from the engines during operation, introducing small quantities of oil and gas components into the surface waters in and surrounding the East Cape Extension and Homestead canals. However, in most cases, any emissions would be diluted by

the volume of water and water movements and would not be expected to cause more than short-term localized minor impacts on water quality. Spill control kits are also typically available from park personnel/marine patrol to address potential spill impacts, if they occur.

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). Water quality 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 water quality 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 water quality 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, respectively

3) Conclusion. No beneficial effects to water quality are anticipated as a result of Alternative A. Alternative A would produce moderate to major adverse impacts on the water quality of park water resources. Consequently, there would be no impairment of water quality 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. Additional sheetpile would be placed, as well as earthen fill and riprap for stabilization and armoring (see Chapter 2 for further construction details). Due to the space limitations at the dam sites, work zones would be established along the banks of the canals. Woody vegetation/debris clearing would be performed along the canal banks for equipment access and to provide a safe work zone. As a result of construction, soils within these work zones at each dam site are likely to be disturbed and compacted, which would increase runoff, potentially contributing to a reduction of water quality in the area. Soils disturbed by construction, as well as potential oil/fuel spills from equipment would contribute to turbidity and pollution in surface waters, respectively. If severe, turbidity would reduce light penetration and visibility and adversely affect aquatic organisms (see Marine Resources section of EA for further details). Also, any increase in nutrients (e.g., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources.

However, to minimize the potential for runoff during construction, BMPs would be implemented during construction. In relation to water quality, 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 runoff entering 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. Therefore, anticipated runoff within the work area would be expected to result in short-term minor to moderate adverse impacts to water quality within the canal work zone areas (within the limits of the turbidity barriers and silt fence) with a potential for short-term negligible to minor adverse impacts to water quality outside of the limits of these erosion control measures. Additionally, no long-term adverse effects are anticipated for water quality as a result of runoff generated from construction of the dams.

Additional staging is anticipated to occur on floating barge(s) along the East Cape Extension canal just south of the work zone and along the Homestead canal just west of the work zone. These staging areas would also be contained within turbidity barriers to further minimize impacts to water quality during construction (e.g., to contain incidental unanticipated discharges of fill material or oil/fuel). Therefore, negligible to minor adverse effects to water quality have the potential to occur at the equipment staging areas.

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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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). 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. 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. This dredging activity would result in short-term moderate to major adverse impacts to water quality within the impact footprint (within the limits of the turbidity barriers) with a potential for short-term negligible to minor adverse impacts to water quality to the areas outside of the turbidity barriers. Additionally, no long-term adverse effects are anticipated for water quality as a result of the dredging activities in Lake Ingraham for the Homestead canal.

The use of NPS spill prevention, control and countermeasure procedures would reduce the potential for petroleum products from leaking equipment or vehicles to reach surface waters. Thus, taking into consideration the impacts and the proposed mitigation measures for incidental spills/discharges, construction activities are anticipated to result in short-term, localized, minor, adverse impacts to water quality within close proximity of the dam site.

The current erosional processes occurring in the canals and interior marshes of the greater Cape Sable area which have the potential to reduce the quality of water within these areas would be greatly reduced with implementation of Alternative C. A decrease in the quantity and velocity of water flow during tidal flows would be expected following dam construction. The flow of saline waters over the marl ridge in the vicinity of the dam sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side creek), consequently reducing the rate of intrusion of saltwater into the interior marshes. In turn, the rate of erosional processes that have the potential to reduce water quality would be decreased and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Thus, the decrease in the current rate of erosion, sedimentation and turbidity, reduction of saltwater intrusion and retention of freshwater would lead to long-term beneficial impacts on overall water quality in the greater Cape Sable area.

Implementation of Alternative C would also prevent illegal motorized boat entry into the wilderness area resulting in a potential benefit to water quality in the waters upstream of the rehabilitated dam. The use of fuels in motorized boats have the potential to create minimal releases from the engines during operation, introducing small quantities of oil and gas components into the surface waters in the wilderness area. However, in most cases, any emissions would be diluted by the volume of water and water movements and would not be expected to cause more than short-term localized minor impacts on water quality. Spill control kits are also typically available from park personnel/marine patrol to address potential spill impacts, if they occur. The armoring of the canal banks in the vicinity of the dam structure would also further reduce the potential for bank alteration by vandals trying to forge a passageway around the structure resulting from the loss of vegetation (due to trampling or hand removal activities) and subsequent facilitated erosion of the banks potentially resulting in a reduction of localized water quality.

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). Water quality 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 water quality 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 water quality 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, respectively.

3) Conclusion. Alternative C would result in minor to moderate short-term adverse impacts to water quality with construction of the East Cape Extension dam and moderate to major adverse impacts with construction of the Homestead canal; however, long-term beneficial effects to water quality are anticipated as a result of implementing Alternative C. Therefore, long-term beneficial effects to park resources in relation to water quality are expected. Consequently, there would not be an impairment of water quality 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 approximate 100-foot plugs centered on the highest elevation point of the marl ridge within the study area along the East Cape Extension and Homestead canals (see Figures 2.3 and 2.4 in Section 2.1.1 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 filling the length of the approximate marl ridge along the East Cape Extension (370') and Homestead (430') canals. Also, 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 impacts during construction of either alternative are a direct result of the placement of the new sheetpile and earthen fill, and riprap for the new plug, stabilization, and armoring (see Chapter 2 for further construction details).

As with Alternative C, above, due to the space limitations at the dam sites, work zones would be established along the banks of the canals. Woody vegetation/debris clearing would be performed along the canal banks for equipment access and to provide a safe work zone. As a result of construction, soils within these work zones at each dam site are likely to be disturbed and compacted, which would increase runoff, potentially contributing to a reduction of water quality in the area. Soils disturbed by construction, as well as potential oil/fuel spills from equipment would contribute to turbidity and pollution in surface waters, respectively. If severe, turbidity would reduce light penetration and visibility and adversely affect aquatic organisms (see Marine Resources section of EA for further details). Also, any increase in nutrients (e.g., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources.

As mentioned above with Action Alternative C, all necessary measures (BMPs), including the use of staked silt fence, turbidity barriers and a temporary mixing zone, would be employed to prevent turbidity (water quality degradation) downstream and/or upstream of each dam site during all construction activities (see above Alternative C discussion on BMPs). 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. Therefore, anticipated runoff within the work area would be expected to result in short-term minor to moderate adverse impacts to water quality within the canal work zone areas (within the limits of the turbidity barriers and silt fence) with a potential for short-term negligible to minor adverse impacts to water quality outside of the limits of these erosion control measures. Additionally, no long-term adverse effects are anticipated for water quality as a result of runoff generated from construction of the dams.

Additional staging is anticipated to occur on floating barge(s) along the East Cape Extension canal just south of the work zone and along the Homestead canal just west of the work zone. These staging areas would also be contained within turbidity barriers to further minimize impacts to water quality during construction (e.g., to contain incidental unanticipated discharges of fill material or oil/fuel). Therefore, negligible to minor adverse effects to water quality have the potential to occur at the equipment staging areas.

As with Alternative C, barge(s) are anticipated to access the work zone for the Homestead canal (only) 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 (see Alternative C analysis above for dredging details). This dredging activity would result in short-term moderate to major adverse impacts to water quality within the impact footprint (within the limits of the turbidity barriers) with a potential for short-term negligible to minor adverse impacts to water quality to the areas outside of the turbidity barriers. Additionally, no long-term adverse effects are anticipated for water quality as a result of the dredging activities in Lake Ingraham for the Homestead canal.

The use of NPS spill prevention, control and countermeasure procedures would reduce the potential for petroleum products from leaking equipment or vehicles to reach surface waters. Thus, taking into consideration the impacts and the proposed mitigation measures for incidental spills/discharges, construction activities are anticipated to result in short-term, localized, minor, adverse impacts to water quality within close proximity of the dam site.

The current erosional processes occurring in the canals and interior marshes of the greater Cape Sable area which have the potential to reduce the quality of water within these areas would be greatly reduced with implementation of Alternatives D or G. A decrease in the quantity and velocity of water flow during tidal flows would be expected following dam construction. The flow of saline waters over the marl ridge in the vicinity of the dam sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side creek), consequently reducing the rate of intrusion of saltwater into the interior marshes. In turn, the rate of erosional processes that have the potential to reduce water quality would be decreased and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Potential erosional impacts on the fill material within the plugs from water overtopping the marl ridge would be minimal due to rooted vegetation and dissipation of flow energy over the length of the plug. Thus, the decrease in the current rate of erosion, sedimentation and turbidity, reduction of saltwater intrusion and retention of freshwater would lead to long-term beneficial impacts on overall water quality in the greater Cape Sable area.

Implementation of Alternative D or G would also prevent illegal motorized boat entry into the wilderness area as with implementing Alternative C, above, but with utilizing a 100-foot or greater plug (i.e., the width of the marl ridge), the potential for bank alteration by vandals trying to forge a passageway around the structure resulting with loss of vegetation (due to trampling or

hand removal activities) and subsequent facilitated erosion of the banks would be greatly reduced, if not entirely eliminated due to the length of the plug and the dense vegetation that exists along the canal banks. Thus, long-term beneficial impacts to park resources would occur as a result of these potential benefits to overall water quality.

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). Water quality 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 water quality 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 water quality 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, respectively.

3) Conclusion. The plugs would allow for a reduction in the intensity and duration of saltwater entering the interior freshwater and brackish marshes via the East Cape Extension and Homestead canals at times when the tides are not overtopping the marl ridge. In addition, this deceleration of salt water intrusion would offer time for the interior marshes of Cape Sable (including the wildlife and vegetation) to restabilize and possibly recover from the current impacts being caused by the failed dams. Alternatives D or G would result in minor to moderate short-term adverse impacts to water quality with construction of the East Cape Extension dam and moderate to major adverse impacts with construction of the Homestead canal; however, long-term beneficial effects to water quality are anticipated as a result of implementing Alternative D or G. Therefore, following completion of the dams, long-term beneficial effects to park resources in relation to water quality are expected. Consequently, there would not be an impairment of water quality as a result of the implementation of Alternative D or G.

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

1) Analysis. Alternative D1 and Alternative G1 are modifications of Alternatives D and G, respectively, and involve installation using geotubes in place of sheetpile walls in the Homestead canal (only). One of the main advantages of this alternative for the Homestead canal dam site would be that dredging of Lake Ingraham for access would not be required. However, 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 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). Therefore, in order to avoid dredging impacts to Lake Ingraham and the potentially resulting short-term impacts to water quality (see analysis for Alternatives D and G, above), fill material would be transported to the Homestead canal work area through a constructed floating pipeline anchored to the northern edge of the existing channel in Lake Ingraham and the eastern edge of the approach channel to the Homestead canal. Since the pipeline would be floating on top of the lake waters, only minor adverse impacts to the substrate of the lake are anticipated to occur from this activity (hence, no adverse water quality concerns). The six to eight inch pipeline would be constructed using a shallow draft barge and would extend from the work area (dam site) 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 to install the pipeline 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 Chapter 2 for further details regarding these alternatives). 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 Florida Bay originating from a designated staging area in the Florida Keys due to a lack of a suitable staging area in Everglades National Park. 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.). This alternative does not involve leveling or excavation in the vicinity of the dam. However, woody vegetation /debris clearing would be performed along the banks for equipment access and to provide for a safe work zone.

As with Alternatives D and G, above, due to the space limitations at the Homestead dam site, the work zone would be established along the banks of the canal. Woody vegetation/debris clearing would be performed along the canal banks for equipment access and to provide a safe work zone. As a result of construction, soils within these work zones at each dam site are likely to be disturbed and compacted, which would increase runoff, potentially contributing to a reduction of water quality in the area. Soils disturbed by construction, as well as potential oil/fuel spills from equipment would contribute to turbidity and pollution in surface waters, respectively. If severe, turbidity would reduce light penetration and visibility and adversely affect aquatic organisms (see Marine Resources section of EA for further details). Also, any increase in nutrients (e.g., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources.

All necessary measures (BMPs), including the use of staked silt fence, turbidity barriers and a temporary mixing zone, would be employed to prevent turbidity (water quality degradation) downstream and/or upstream of each Homestead canal dam site during all construction activities (see above Alternative C discussion on BMPs). 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 area in the canal once turbidity has subsided following construction completion of the dam. Therefore, anticipated runoff within the work area would be expected to result in short-term minor to moderate adverse impacts to water quality within the canal work zone area (within the limits of the turbidity barriers and silt fence) with a potential for short-term negligible to minor adverse impacts to water quality outside of the limits of these erosion control measures. Additionally, no long-term adverse effects are anticipated for water quality as a result of runoff generated from construction of the dam.

The current erosional processes occurring in the Homestead canal and interior marshes of the greater Cape Sable area, which have the potential to reduce the quality of water within these areas, would be greatly reduced with implementation of Alternative D1 or Alternative G1. A decrease in the quantity and velocity of water flow during tidal flows would be expected following dam construction. The flow of saline waters over the marl ridge in the vicinity of the dam sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side creek), consequently reducing the rate of intrusion of saltwater into the interior marshes. In turn, the rate of erosional processes that have the potential to reduce water quality would be decreased and would result in an increase of the retention of freshwater from wet season rains in the interior freshwater and brackish marshes. Potential erosional impacts on the fill material within the plug from water overtopping the marl ridge would be minimal due to rooted vegetation and dissipation of flow energy over the length of the plug. Thus, the decrease in the current rate of erosion, sedimentation and turbidity, reduction of saltwater intrusion and retention of freshwater would lead to long-term beneficial impacts on overall water quality in the greater Cape Sable area.

Implementation of Alternative D1 or Alternative G1 would also prevent illegal motorized boat entry into the wilderness area as with implementing Alternative D or G, above. Moreover, the proposed canoe/kayak portages would provide safe passage over the dams further reducing the potential for adverse impacts to the adjacent wetland vegetation and canal banks. Subsequently, the aesthetics of park water resources would be maintained or enhanced with repair of the Homestead canal dam resulting in a benefit to park visitors. Thus, long-term beneficial impacts to park resources would occur as a result of these potential benefits to overall water quality.

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). Water quality 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 water quality 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 water quality 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, respectively.

3) Conclusion. Alternative D1 or Alternative G1 would allow for a reduction in the intensity and duration of saltwater entering the interior freshwater and brackish marshes through the Homestead canal at times when the tides are not overtopping the marl ridge. In addition, this deceleration of salt water intrusion would offer time for the interior marshes of Cape Sable (including the wildlife and vegetation) to restabilize and possibly recover from the current impacts being caused by the failed dams. Alternative D1 or Alternative G1 would result in minor

to moderate short-term adverse impacts to water quality with construction of the Homestead canal dam; however, long-term beneficial effects to water quality are anticipated as a result of implementing Alternative D1 or Alternative G1. Therefore, following completion of the dams, long-term beneficial effects to park resources in relation to water quality are expected. Consequently, there would not be an impairment of water quality as a result of the implementation of Alternative D1 or Alternative G1.

3.4.2.3.3 Vegetation and Wetlands

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 would 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 would 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, 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 3.1, below:

Table 3.1 – Direct Impacts to Wetlands/Surface Waters for Alternative C

Wetland/Surface Water ID[3]	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
E1UBLx	Fill and Riprap - Permanent	East Cape Extension Canal	2,732.54	0.063
E1UBLx	New Sheetpile - Permanent	East Cape Extension Canal	67.77	0.001
E2SS3P/E2EMP	Riprap - Permanent	Banks of East Cape Extension Canal	3,522.52	0.081
E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
E2SS3P/E2EMP	New Sheetpile - Permanent	Banks of East Cape Extension Canal	499.82	0.011
E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of East Cape Extension Canal	6,652.73	0.153
E1UBLx	Fill and Riprap -	Homestead Canal	2,848.15	0.065

[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.

	Permanent			
E1UBLx	New Sheetpile - Permanent	Homestead Canal	122.05	0.003
E2SS3P/E2EMP	Riprap - Permanent	Banks of Homestead Canal	4,112.58	0.095
E2SS3P/E2EMP	New Sheetpile - Permanent	Banks of Homestead Canal	469.66	0.011
E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	7,917.63	0.182
E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of Homestead Canal	38,798.32	0.891
E2USM/N	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, approximately 0.002 acres (90 square feet) of permanent shading impacts to 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 resources are known to exist within these waterways, this new shading impact is negligible. Also, floating mooring buoys would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. 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 resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

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 2.4 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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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. Thus, no additional mitigation is anticipated for this temporary impact.

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 3.2 below. In Table 3.2, "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 severly 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 in the Wetland SOF in Appendix A.

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.

Table 3.2 – 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

As shown in Table 3.2, 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 Chapter 2 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 aerial the footprint 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 (mitigation sites) 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 3.3, below. Copies of the UMAM scores for the mitigation areas have been enclosed in Attachment D.

Table 3.3 – 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 [mitigation Delta / (risk x 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, 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 2.3 and 2.4 in Section 2.1.1 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 3.4 and 3.5:

Table 3.4 – Direct Impacts to Wetlands/Surface Waters for Alternative D

	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	*E1UBLx*	Fill and Riprap - Permanent	East Cape Extension Canal	1,664.18	0.038
	E1UBLx	New Sheetpile - Permanent	East Cape Extension Canal	607.78	0.014
	E1UBLx	Plug Fill - Permanent	East Cape Extension Canal	5,470.78	0.126
	E2SS3P/E2EMP	Riprap - Permanent	Banks of East Cape Extension Canal	3,970.57	0.091
	E2SS3P/E2EMP	New Sheetpile	Banks of East Cape	400.00	0.011

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.

	Wetland/Surface Water ID[4]	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
		Permanent	Extension Canal		
	E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
	E2SS3P/E2EMP	Work Zone Clearing Temporary	Banks of East Cape Extension Canal	8,551.11	0.196
Homestead Canal	*E1UBLx*	Fill and Riprap - Permanent	Homestead Canal	2,107.32	0.048
	E1UBLx	New Sheetpile - Permanent	Homestead Canal	445.64	0.010
	E1UBLx	Plug Fill - Permanent	Homestead Canal	4,105.33	0.094
	E2SS3P/E2EMP	Riprap - Permanent	Banks of Homestead Canal	3,127.24	0.072
	E2SS3P/E2EMP	New Sheetpile - Permanent	Banks of Homestead Canal	563.75	0.013
	E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	8,337.40	0.191
	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
	E2USM/N	Access Dredging - Temporary	Substrate of Lake Ingraham	1,431,040.00	32.852

Table 3.5 – Direct Impacts to Wetlands/Surface Waters for Alternative G

	Wetland/Surface Water ID[5]	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
East Cape Extension Canal	*E1UBLx*	Fill and Riprap - Permanent	East Cape Extension Canal	1,664.18	0.038
	E1UBLx	New Sheetpile - Permanent	East Cape Extension Canal	607.78	0.014
	E1UBLx	Plug Fill - Permanent	East Cape Extension Canal	5,470.78	0.126
	E2SS3P/E2EMP	Riprap - Permanent	Banks of East Cape Extension Canal	3,970.57	0.091
	E2SS3P/E2EMP	New Sheetpile - Permanent	Banks of East Cape Extension Canal	499.90	0.011
	E2SS3P/E2EMP	Mangrove Trimming - Temporary	Banks of East Cape Extension Canal	18,081.08	0.415
	E2SS3P/E2EMP	Work Zone Clearing Temporary	Banks of East Cape Extension Canal	8,551.11	0.196
Hom este	*E1UBLx*	Fill and Riprap - Permanent	Homestead Canal	2,107.32	0.048
	E1UBLx	New Sheetpile	Homestead Canal	445.64	0.010

[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.

	Wetland/Surface Water ID[5]	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
		Permanent			
	E1UBLx	Plug Fill - Permanent	Homestead Canal	4,105.33	0.094
	E2SS3P/E2EMP	Riprap - Permanent	Banks of Homestead Canal	3,127.24	0.072
	E2SS3P/E2EMP	New Sheetpile - Permanent	Banks of Homestead Canal	563.75	0.013
	E2SS3P/E2EMP	Temp. Work Zone Clearing - Temporary	Banks of Homestead Canal	8,337.40	0.191
	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
	E2USM/N	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 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, approximately 0.002 acres (90 square feet) of permanent shading impacts to 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 resources are known to exist within these waterways, this new shading impact would be negligible. Also, floating mooring buoys would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. 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 resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

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 2.4 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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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 may serve as mitigation for dredging impacts to Lake Ingraham.

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 Chapter 2 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 3.6 and 3.7, below. UMAM assessment forms for the impact areas have been provided in the Wetland SOF in Appendix A.

Table 3.6 – 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

	Impact Area ID	Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
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 3.6, 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 3.7 – 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 3.7, 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 Chapter 2 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 aerial the footprint 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, the results 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 3.8 and 3.9.

Table 3.8 – UMAM Functional Assessment 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

Mitigation Area ID		Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
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 3.8, 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 3,117.464; 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 3.9 – UMAM Functional Assessment 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

	Mitigation Area ID	Assess. Area Size	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
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
	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, 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)

1) Analysis. 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 2.4 in Section 2.1.1 depicting 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 3.10, below:

Table 3.10 – Direct Impacts to Wetlands/Surface Waters for Alternatives D1 and G1

	Wetland/Surface Water ID[6]	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

6 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.

	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 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 would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. As a result, the moorings would minimize potential secondary impacts to the canal bottom from the use of standard boat anchors. Since no submerged resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

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 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). 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 Chapter 2 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 2.4 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 Chapter 2 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 3.11, below. UMAM assessment forms for the impact areas have been provided in the Wetland SOF in Appendix A.

Table 3.11 – UMAM Functional Assessment – 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 3.11, 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 Chapter 2 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 aerial the footprint 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, the results 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 3.12.

Table 3.12 – 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, 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.

3.5 Wildlife and Wildlife Habitat

3.5.1 Affected Environment

The Everglades is a low, flat plain shaped by the action of water and weather, including fire, where slight changes in elevation, water salinity, and soils create a variety of different landscapes (NPS 2009c). These landscapes each support their own community of plants and wildlife, including approximately 350 birds, more than 40 mammals, more than 50 reptiles, and 15 amphibians (NPS 2009b). Not all of these animals or plant communities occur in the project area, so the following sections focus on the wildlife, including aquatic species, and vegetation that may be affected.

The primary project area is surrounded by vegetation types that provide habitat for a variety of wildlife, including salt marshes, and mangrove swamps (NPS 2009c, USGS 2001). The vegetation of these communities is described in more detail in the "Vegetation and Wetlands" section of this document. Salt marsh communities occur at the interface of the land and sea, and are subject to occasional flooding. This environment is very stressful for animal life because of the dramatic, irregular, and sudden fluctuations in salinity and water level. As a result, few fish, reptiles, birds, or mammal species are considered residents of salt marshes. These habitats are found interspersed with mangroves. Mangroves occur in an estuary system that is a valuable nursery for shrimp and fish, and provide foraging and nesting habitat for many birds (NPS 2003, 2009c). Mangrove communities occur along the canals and surrounding Lake Ingraham. Aquatic habitats in the project area include brackish and marine environments. The marine habitats in the project area are characterized by the brackish interface between freshwater and Florida Bay (NPS 2003). Seagrass beds also serve as food for many marine species and provide the primary productivity and shelter that supports hundreds of associated animal species. Combined, these habitats support wildlife species, many of which are considered endangered or threatened, or of special concern, by the federal government or the state. Those "listed species" are addressed in the "Special Status Species" section of this document. Some of the more common fish and wildlife species observed in the area are listed in Table 3.13.

Table 3.13 – Common Wildlife in the Cape Sable Area

Common Name	Scientific Name
Mammals	
Virginia opossum	*Didelphis virginiana*
Raccoon	*Procyon lotor*
Bobcat	*Lynx rufus*
Marsh rabbit	*Sylvilagus palustris*
Marsh rice rat	*Oryzomys palustris*
Birds	
Double-crested cormorant	*Phalacrocorax auritus*
Great egret	*Ardea albus*
Great blue heron	*Ardea herodias*
Cattle egret	*Bubulcus ibis*
Green heron	*Butorides virescens*
Black-crowned night-heron	*Nycticorax nycticorax*
Laughing gull	*Larus atricilla*
Ring-billed gull	*Larus delawarensis*
White ibis	*Eudocimus albus*
Turkey vulture	*Cathartes aura*
Red-shouldered hawk	*Buteo lineatus*

Common Name	Scientific Name
Killdeer	*Charadrius vociferus*
Black-bellied plover	*Pluvialis squatarola*
Black-necked stilt	*Himantopus mexicanus*
Wouldet	*Tringa semipalmata*
Laughing gull	*Larus atricilla*
Ring-billed gull	*Larus delawarensis*
Forster's tern	*Sterna forsteri*
Mangrove cuckoo	*Coccyzus minor*
Red-bellied woodpecker	*Melanerpes carolinus*
Gray kingbird	*Tyrannus dominicensis*
Reptiles	
Ornate diamondback terrapin	*Malaclemys terrapin macrospilota*
Mangrove salt marsh snake	*Nerodia clarkii compressicauda*
Corn snake	*Elaphe guttata guttata*
Rat snake	*Elaphe obsoleta rossalleni*
Green anole	*Anolis carolinensis*
Brown anole	*Anolis sagrei*
Southeastern five-lined skink	*Eumeces inexpectatus*
Fish	
Southern stingray	*Dasyatis americana*
Tarpon	*Megalops atlanticus*
Ladyfish	*Elops saurus*
Bay anchovy	*Anchoa mitchilli*
Hardhead sea catfish	*Arius felis*
Goldspotted killifish	*Floridichthys carpio*
Rainwater killifish	*Lucania parva*
Common snook	*Centropomus undecimalis*
Crevalle jack	*Caranx hippos*
Mangrove snapper	*Lutjanus griseus*
Mojarras	*Eucinostomus*
Grunts	*Haemulon* spp.
Pinfish	*Lagodon rhomboides*
Sheepshead	*Archosargus probatocephalus*
Spotted seatrout	*Cynoscion nebulosus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
Mullet	*Mugil* spp.
Southern puffer	*Sphoeroides nephelus*

Source: NPS 2003, Smithsonian 2002, FishBase 2007

In addition to native wildlife, many non-native animals also occur at Everglades National Park. These include pets that have been turned loose, such as pythons (*Python molurus*), iguanas, parakeets, and parrots. Aquatic environments have also been invaded by non-native species, including blue and spotted tilapias (*Oreochromis aureus* and *Tilapia mariae*, respectively), oscars (*Astronotus ocellatus*), and Mayan cichlids (*Cichlasoma urophthalmus*) (NPS 2009a).

The interaction between native and non-native species depends on local environmental conditions that would include habitat patches and water temperature. Environmental disturbances, including hurricanes, construction of water control measures, and tropical storms would elevate water levels in the park and increase the distribution of these species throughout the park (Trexler et al. 2000). No native species extinctions or widespread species community

disruptions resulting from the introduction of exotics were noted. However, it should not be inferred that exotic species have no effect on native communities; over time, it is possible that non-native species would adversely impact native communities.

3.5.2 Environmental Consequences

3.5.2.1 Guiding Regulations and Policies

The NPS Organic Act of 1916 and the NPS *Management Policies 2006* (NPS 2006b) direct parks to provide for the protection of park resources. The NPS *Management Policies 2006* state that "the Service would not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it would try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems. Just as all components of a natural system would be recognized as important, natural change would also be recognized as an integral part of the functioning of natural systems."

3.5.2.2 Assumptions, Methodology, and Intensity Thresholds

Maps showing vegetation cover within the Cape Sable area and communications with NPS staff were used to identify baseline conditions for wildlife, wildlife habitat, and vegetation. Available information was also taken from other NPS and non-NPS resources to describe these resources in more detail.

In general, it was assumed that there would be impacts to wildlife and wildlife habitat that occur from the construction phase of the action alternatives, as well as post-construction effects. The primary steps taken in assessing impacts on wildlife and wildlife habitat (including vegetation) included determining:

1. Which species are found in areas likely to be affected by management actions described in the alternatives;
2. Habitat/vegetation loss or alteration caused by the alternatives; and
3. Displacement and disturbance potential of the actions and the species' potential to be affected by construction or future use and management activities.

The thresholds for the intensity of an impact are defined as follows:

Negligible: There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations.

Minor: A change in effects on wildlife and habitats would be localized within a small area. The change would be measurable or perceptible in terms of abundance, distribution, quantity, or quality of populations. While the mortality of individual animals might occur, the viability of wildlife populations would not be affected and the community, if left alone, would recover. Impacts would be detectable and are expected to be outside the natural range of variability.

Moderate: A change in effects on wildlife and habitats would occur over a relatively large area. The change would be readily measurable in terms of abundance, distribution, quantity, or quality of populations. Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and would be outside the natural range of variability. Disruptions to key ecosystem processes that would be outside natural variation might occur, but the

ecosystem would soon return to natural conditions. Mitigation measures would probably be necessary to compensate for adverse effects and would likely be successful.

Major: A change in effects on wildlife and habitats would be readily apparent, and would substantially change wildlife populations over a large area in and out of the park. Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and would be expected to be outside the natural range of variability or be permanent. Key ecosystem processes might be disrupted. Loss of habitat might affect the viability of at least some native species. Extensive mitigation would be needed to compensate for adverse effects, and its success would not be assured.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to the existing failed dams along the marl ridge that would be directly affected by the proposed actions; however, impacts to wildlife in the expanded area of analysis in the greater Cape Sable area originating at the dam sites are also discussed.

3.5.2.3 Impacts of the Alternatives

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 wildlife and wildlife habitat 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 only prolong the anthropomorphic impacts on erosional processes within these canals and the greater Cape Sable area. These processes would continue to act at current or potentially increasing rates. Related erosion and channel widening would be expected to continue resulting in long term degradation of adjacent and downstream wildlife habitats. Long-term, indirect, minor to moderate adverse impacts to wildlife and wildlife habitat are anticipated to continue to occur as a result of off-trail use by visitors.

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). Wildlife and habitat 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 wildlife and habitat 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 wildlife and habitat 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, respectively.

3) Conclusion. No direct impacts to wildlife and wildlife habitat areas would result with Alternative A. There would be long-term, negligible to minor adverse impacts resulting from ongoing visitor use in and around the existing dam site. No beneficial effects to wildlife are anticipated as a result of Alternative A. Alternative A would produce long-term minor to moderate adverse impacts on wildlife and habitat resources. Consequently, there would not be an impairment of wildlife and wildlife habitat as a result of Alternative A.

Action Alternatives C (Repair in Place), D (New 100' Plug – Marl Ridge Location), G (New 370'/430' Plug - Marl Ridge Location), D1 (New 100' Plug - Geotubes), and G1 (New 430' Plug - Geotubes)

1) Analysis. In the areas directly adjacent to the existing East Cape Extension and Homestead canal dams, the noise associated with the construction, vegetation removal, and presence of people during those activities would temporarily displace some wildlife in adjacent habitats, but it is not likely that community or population changes would occur. Displaced wildlife would increase competition between individuals in the surrounding habitats. Some less mobile individuals would even be killed during construction activities, but mitigation measures would be taken to minimize the potential (such as removing individuals that get trapped). Aquatic wildlife in the area of construction would be displaced, and benthos at the sheetpiles, riprap and plug locations would be lost. Temporary loss of habitat during construction is expected to occur with these alternatives, and permanent loss of habitat is also involved (at an increasing level) with Alternatives C, D/D1, and G/G1 (please refer to "Vegetation and Wetlands" section for impact analysis of habitat loss). There is also the potential for erosion and sedimentation during construction activities, as well as petroleum spills from equipment, to contribute to turbidity and pollution in surface waters. However, pre- and post-construction erosion control BMPs would minimize impacts, including the installation and inspection of silt fences, straw bale barriers, temporary earthen berms, sediment traps, or other equivalent measures; and the revegetation of disturbed areas.

Steps would be taken to minimize the introduction of non-native species, which would affect the makeup of wildlife habitat, during and after construction. These would include washing equipment before entering the park; minimizing disturbances; initiating revegetation of disturbed areas immediately after construction; salvaging topsoil and native vegetation from the area, and limiting the amount of topsoil imported for revegetation; using seeds from native species during revegetation; and monitoring reclamation, implementing exotic species control as necessary. The permanent footprint for the rehabilitated dam would increase, but following completion of the project, wildlife would be expected to reoccupy all available habitat in and adjacent to the sites.

Over the long-term, beneficial impacts to wildlife resulting from potential decrease in saltwater intrusion would be anticipated. Because the project is small in scale detectable improvements in wildlife habitat conditions would not likely be measurable. The rehabilitation of the dam would result in a minor, adverse effect and loss of useable habitat by wildlife. It is anticipated that the project would result in a temporary loss of resting, shelter, and foraging sites for mammals. For birds, the project would result in a temporary loss of nesting, loafing, roosting, and foraging sites. For amphibians and reptiles, the plugs would result in a net loss of resting, shelter, nesting, and foraging sites. The plugs (Alternatives D/D1 and G/G1) would be expected to provide a type of artificial habitat similar to the canal banks. Impacts on native invertebrates in the construction area would be minor and adversely affected over the long-term by the placement of the plug. Also, because access to the backcountry would be restricted after the rehabilitation of the dam, there would be long-term beneficial impacts to the wildlife due to the absence of motorized boaters in the area.

Based on the small scale of the project compared to the overall existing habitat in the area, it is estimated that the rehabilitation of the dam would produce adverse, local, minor, short-term effects but beneficial long-term impacts to wildlife.

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). Wildlife and habitat 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 wildlife and habitat would occur as a result of combining the cumulative projects with the actions contained in Alternative C, D/D1, or G/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 C, D/D1, or G/G1. For more information on the cumulative projects and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3, respectively.

3) Conclusion. Any of these action alternatives would result in minor short-term adverse impacts from construction activities but beneficial long-term effects on wildlife and wildlife habitat from reduced visitor use, improved hydrologic conditions and reduced saltwater intrusion. Consequently, if any of the action alternatives is implemented, there would be no impairment to wildlife and wildlife habitat.

3.6 Marine Resources and Essential Fish Habitat

3.6.1 Affected Environment

The marine and estuarine resources of the Cape Sable area include important park elements such as submerged aquatic vegetation (seagrass communities), mangroves, wading birds, crocodiles, manatees, and wetlands. Surface waters in and around Cape Sable are classified by the state as Outstanding Florida Waters (OFW), as are all waters within Everglades National Park. An OFW is a waterbody designated worthy of special protection because of its natural attributes, and the designation is intended to protect existing good water quality (Florida DEP 2007a). Because surface waters of the Cape Sable area are of high quality, they are particularly susceptible to degradation.

Prior to canal construction, Lake Ingraham was an isolated fresh to brackish lake within the coastal system. From the north, Little Sable creek extended to Lake Ingraham over a long distance. From the south, saline water would have entered only during storm tides (Wanless, 2005). The canal system that was built in the 1920s provided large volumes of sediment into Lake Ingraham, slowly filling it high enough in the intertidal zone for mangroves to colonize. Nearly the entire delta is emergent at low tide. In spite of the high rate of sedimentation on Lake Ingraham's delta, there are abundant algae and cyanobacteria, burrowing worms and other animal species which still provide a desirable feeding habitat for many wetland and wading birds species.

Also prior to canal construction, the interior of Cape Sable was a freshwater marsh with patches of brackish marsh and swamp. The marl ridge provided a boundary between Florida Bay and the interior. The beaches and capes provided a second, western barrier between the Gulf of Mexico and the interior. With the construction of the canals, the marsh levels lowered and

started to collapse, due to possibly three reasons: (1) the opening of the canals to the shore would have resulted in a lowering of the marsh levels; (2) 1935 Labor Day Hurricane sent out a six-foot storm surge plus waves across Cape Sable, ripping up areas of marsh; and (3) abrupt saline intrusion through the canals.

Essential Fish Habitat (EFH) is the geographic area and associated habitats where managed species inhabit throughout its life-cycle to support breeding, spawning, nursery, feeding, and protection functions. EFH would be described by location, ecological characteristics, and time. The type of habitat available, its characteristics, and its functions are important to the species' productivity, diversity, health and survival.

Essential fish habitats within the park, as defined by the fishery management councils, include:

- submerged aquatic vegetation (SAV) (seagrasses)
- intertidal vegetation (marshes and mangrove)
- benthic algae
- reefs
- sand/shell bottoms
- soft bottoms
- pelagic, oyster reefs, and shell banks
- hard bottoms

A description of mangroves for the park has been provided in the "Vegetation" section of this chapter. The following description and importance of these essential fish habitats have been taken from the Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plan of the Gulf of Mexico (GMFMC, 2004).

Seagrass meadows provide substrates and environmental conditions that are essential to the feeding, spawning, and growth of several managed species. Juvenile and adult invertebrates and fishes, as well as their food sources, utilize seagrass beds extensively (GMFMC 2004).

Mangroves and marshes provide essential habitat for many managed species, serving as nursery grounds for larvae, postlarvae, juveniles, and adults. Mangrove habitats, particularly riverine, overwash and fringe forests, provide shelter for larval, juvenile and adult fish, and invertebrates. Along with providing habitat for fish during various life-cycle stages, mangroves and marshes provide inputs of dissolved and particulate organic detritus to estuarine food webs. Because of this linkage, both as habitat and as food resources, mangroves are important exporters of material to coastal systems, as well as to terrestrial systems by providing shelter, foraging grounds, and nursery/rookery areas for terrestrial organisms. The root system binds sediments, thereby contributing to sedimentation and sediment stabilization (GMFMC 2004).

Corals and coral reefs support a wide array of hermatypic and ahermatypic corals, finfish, invertebrates, plants, and microorganisms.

Hard bottoms and hard banks often possess high species diversity but may lack hermatypic corals, the supporting coralline structure, or some of the associated biota. Hard bottoms are usually of low relief and on the continental shelf; many are associated with relic reefs, where the coral veneer is supported by dead corals. In deeper waters, large, elongated mounds, called deepwater banks and hundreds of meters in length, often support a rich fauna compared with adjacent areas.

Benthic algae occur in both estuarine and marine environments and are used as habitat by managed species, such as the queen conch and early-life history stages of the spiny lobster. Threatened sea turtles utilize some benthic algae species directly as food. This habitat is also

inhabited by invertebrate species, including mollusks and crustaceans, which are eaten by various fishes.

Sand/shell and soft bottom habitats are common throughout Florida and the Caribbean. These habitats are characterized as being high-energy and extremely dynamic. However, buffering by reefs and seagrasses allows some salt-tolerant plants to colonize the beach periphery. Birds, sea turtles, crabs, clams, worms, and urchins use the intertidal areas. The sand/mud subsystem includes all non- live bottom habitats or those with low percent cover (less than 10%). Sandy and mud bottom habitats are widely distributed, found in coastal and shelf areas, and include inshore, sandy areas separating living reefs from turtle grass beds and shorelines, rocky bottoms near rocky shorelines, and mud substrates along mangrove shorelines. Sand/shell habitat is utilized for foraging by abundant fishes, such as mojarras, and as substrate for solitary corals.

The **pelagic** subsystem explicitly includes the habitat of pelagic fishes. Pelagic habitat is associated with open waters beyond the direct influence of coastal systems. In general, primary productivity in this zone is low and patchily distributed, being higher in nearshore areas as opposed to offshore areas. The pelagic system is inhabited by the eggs and larval stages of many reef fishes, highly migratory fishes, and invertebrates, some of which, like the spiny lobster, are commercially important.

Oyster and shell EFH would be defined as the natural structures found between (intertidal) and beneath (subtidal) tide lines that are composed of oyster shell, live oysters, and other organisms that are discrete. Oysters have often been described as the “keystone” species in an estuary and provide substantial surface area as habitat. Oyster communities are critical to a healthy ecosystem, since oyster reefs would remove, via filter feeding, large amounts of particulate material from the water column and release large quantities of inorganic and organic nutrients. The ecological role of the oyster reef as structure, providing food and protection, contributes to its value as a critical fisheries habitat.

Whereas EFH must be described and identified for each species and life stage in the fisheries management unit, habitat areas of particular concern (HAPC) are identified on the basis of the condition of the habitat. The final rule to implement the essential fish habitat provisions of the *Magnuson-Stevens Fisheries Act* lists the following considerations in the designation of HAPCs (50 CFR 600.815 (a) (8)):

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether, and to what extent, development activities are, or would be, stressing the habitat; and
- The rarity of the habitat type.

The designation of HAPC is intended to identify for anyone considering actions that might be potentially threatening to a habitat, those areas of EFH considered to be of the highest importance in the life cycles of managed species and most in need of protection. A HAPC is expected to be a localized area of an EFH that is especially ecologically important, sensitive, stressed, or rare, when compared to the rest of the EFH (NOAA 2009a).

Florida Bay in the Everglades National Park has been identified as a HAPC. Mangrove covered islands and SAV within the bay provide important habitat for many of the fisheries, such as pink shrimp, red drum, and spiny lobster. Categories of EFH that would be affected by the proposed project include the estuarine/marine water column and non-vegetated bottom (with mud, sand,

and rock substrates). EFH for the highly migratory pelagic species would be restricted to the estuarine/marine water column; EFH for the remaining species also includes the non-vegetated bottom.

The EFH within Everglades National Park is comprised of estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities); including submerged vegetation (seagrasses and algae), marshes and mangroves, and oyster shell (GMFMC 2004).

The Gulf of Mexico Fisheries Management Council identified six areas within Everglades National Park – Florida Bay, Lake Ingraham, Whitewater Bay, Cape Sable to Lostman's River, Lostman's River to Mormon Key, and Mormon Key, up to and beyond the park boundary, to Caxambas Pass – that contain EFH dominated by mangrove islands and mangrove forests that include marsh areas and areas of submerged aquatic vegetation (seagrass). The complex of six areas is referred to as the Florida Bay and Ten Thousand Islands area. Mangroves in this area comprise approximately 117,970 hectares, and marsh areas 107,488 hectares. Cape Sable contains about two thirds of the tidal marsh and greater than 60 percent of the mangroves for the area. Submerged vegetation in the area totals nearly 106,840 hectares, contained mostly within Florida Bay.

The EFH within the Park provide forage, nursing and spawning areas for species, such as shrimp, red drum, spiny lobster, reef fish, and mackerels. Table 3.14 provides a list of species that have been observed or recorded in the Fishery Management Plans and associated amendments as present in the park, species that are potentially located within the project area, or species that have prey items that are found in the project area (GMFMC 2004). The table provides an indication of the EFH identified for each federally managed species that occur within the park.

Table 3.14 – Federally Managed Fish Species Using Essential Fish Habitats within Everglades National Park

Common Name	Scientific Name	Habitat
Red Drum		
Red Drum	*Sciaenops ocellatus*	Marine planktonic, SAV, mud bottom, marsh
Reef Fish		
Gray triggerfish	*Balistes capriscus*	Marine sand, floating plants, mangroves
Greater amberjack	*Seriola dumerili*	Floating plants, pelagic
Lesser amberjack	*Seriola fasciata*	Floating plants, pelagic
Red snapper	*Lutjanus campechanus*	Sand, mud, rock outcrops, gravel
Gray (mangrove) snapper	*Lutjanus griseus*	Marine planktonic, SAV, mangrove, mud
Lane snapper	*Lutjanus synagris*	SAV, mangrove, mud, sand, reefs
Yellowtail snapper	*Ocyurus chrysurus*	SAV, mangrove, mud, sand, reefs
Vermilion snapper	*Rhomboplites aurorubens*	SAV, mangrove, mud, sand, reefs
Golden tilefish	*Lopholatilus chamaeleonticeps*	Burrows, rough bottom
Red grouper	*Epinephelus morio*	Marine planktonic, SAV, hard bottoms
Black grouper	*Mycteroperca bonaci*	Marine planktonic, SAV, hard bottoms
Gag grouper	*Mycteroperca microlepis*	Marine planktonic, SAV, hard bottoms
Scamp	*Mycteroperca phenax*	Hard bottoms, reefs
Coastal Migratory Pelagic		
King mackerel	*Scomberomorus cavalla*	Pelagic
Spanish mackerel	*Scomberomorus maculates*	Pelagic
Cobia	*Rachycentron canadum*	Coastal
Cero	*Scomberomorus regalis*	Pelagic
Little tunny	*Euthynnus alletteratus*	Estuaries, pelagic

Common Name	Scientific Name	Habitat
Dolphin	*Coryphaena hippurus*	Epipelagic
Bluefish	*Pomatomus saltatrix*	Estuaries, pelagic
Shrimp		
Brown shrimp	*Penaeus aztecus*	Marsh, mud
White shrimp	*Penaeus setiferus*	Marsh, mud
Pink shrimp	*Penaeus duorarum*	Sand
Royal red shrimp	*Pleoticus robustus*	SAV
Spiny Lobster		
Spiny lobster	*Panulirus argus*	Hard bottoms
Spotted spiny lobster	*Panulirus guttatus*	Hard bottoms
Smooth tail lobster	*Panulirus laevicauda*	Hard bottoms
Spanish slipper lobster	*Scyllarides aequinoctialis*	Hard bottoms

SAV: Submerged aquatic vegetation; Source: Gulf of Mexico Fishery Management Council, 2009b

The proposed project is located in an area for which the Gulf of Mexico Fisheries Management Council (GMFMC) has designated EFH for species managed under five fishery management plans (FMPs): penaeid shrimp, red drum, reef fish, spiny lobster, and highly migratory pelagic species, including the following species and life stages:

- ***Shrimp FMP:*** postlarval and juvenile pink shrimp, and postlarval, juvenile, and subadult white, royal red and brown shrimp.
- ***Red drum FMP:*** postlarval, juvenile, and adult red drum.
- ***Reef fish:*** gray snapper, red snapper, lane snapper, yellowtail snapper, and vermilion snapper.
- ***Spiny lobster FMP:*** Larval, postlarval, juvenile, and adult spiny lobster and the incidental species: spotted spiny lobster*;* smooth tail lobster; and Spanish lobster.
- ***Highly migratory pelagic species:*** bluefish, larval cobia, adult Spanish mackerel, King mackerel, cero, little tunny and dolphin.

Although described in Section 3.7.1 (Special Status Species), it is important to note that the NMFS is currently proposing to designate critical habitat for the smalltooth sawfish (*Pristis pectinata*), which was listed as endangered in 2003, under the Endangered Species Act (ESA). Critical habitat is defined by Section 3 of the ESA as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species." The proposed critical habitat consists of two units: the Charlotte Harbor Estuary Unit, which comprises approximately 221,459 acres of coastal habitat; and the Ten Thousand Islands/Everglades Unit (TTI/E), which comprises approximately 619,013 acres of coastal habitat. The TTI/E Unit includes the project area. The proposed specific areas contain the following physical and biological features that are essential to the conservation of this species and that may require special management considerations or protection: red mangroves and shallow euryhaline habitats characterized by water depths between the Mean High Water (MHW) line and 3 ft (0.9 m) measured at Mean Lower Low Water (MLLW). The primary impacts of a critical habitat designation result from the ESA section 7(a)(2) requirement that Federal agencies ensure their actions are not likely to result in destruction or adverse modification of

critical habitat, and that their actions are not likely to jeopardize the species' continued existence.

3.6.2 Environmental Consequences

3.6.2.1 Guiding Regulations and Policies

The Council on Environmental Quality guidelines for implementing the NEPA requires an analysis of resources that would be considered ecologically critical areas. Within Everglades National Park, ecologically critical areas include: EFH, as identified by the Gulf of Mexico Fisheries Management Council (GMFMC 2005), and habitat areas of particular concern, as defined by the National Oceanic and Atmospheric Administration and mapped by the councils listed above.

In 1996, Congress made substantial revisions to the Magnuson-Stevens Fisheries Act and refined the focus of fisheries management by emphasizing the need to protect fish habitat. Specifically, the Act required that fishery management plans identify as EFH those areas that are necessary to fish for their basic life functions. EFH is defined as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (NOAA, 2009b).

The Magnuson-Stevens Act requires the National Marine Fisheries Service (NMFS) and regional fishery management councils to minimize, to the extent practicable, adverse effects to EFH caused by fishing activities. The Act also requires federal agencies to consult with NOAA Fisheries about actions that would damage EFH. No changes were made to the EFH mandate during the 2006 Magnuson-Stevens Act Reauthorization (NOAA, 2009b).

3.6.2.2 Assumptions, Methodology, and Intensity Thresholds

The intent of the 1996 *Magnuson-Stevens Fishery Conservation and Management Act* is to conserve and enhance EFH and focus conservation efforts on areas that are important to the life cycles of federally managed fish and shellfish. For this EA, it includes the protection of estuarine systems (mangroves and salt marshes), seagrasses, and hard-bottom habitats that provide refuge, foraging, and breeding areas for fish and invertebrates. For a detailed analysis of effects for mangroves, salt marshes, and seagrasses, please refer to the "Vegetation and Wetlands" section of this document.

The following thresholds were used to determine the magnitude of impacts on EFH:

Negligible: The waters and substrates that define the EFH would not be affected or the effects would be at or below the level of detection, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the EFH. Fisheries or invertebrate species that depend upon these habitats would not be affected.

Minor: Effects to waters and substrates that define the EFH would be detectable, although the effects would be localized, and would be small and essential habitat would not be lost in the area. The function of the habitat for fisheries or invertebrate species would not be affected. Although some individuals may avoid areas that are affected, populations of the fish and invertebrate species that use these habitats would not be affected.

Moderate: Effects to waters and substrates that define the EFH would be readily detectable resulting in a loss of small portions of habitat and it would lose some of its function for fisheries or invertebrate species that depend upon it. This would result in a decline in populations of these fish or invertebrates in the local area.

Major: Effects to waters and substrates that define the EFH would be widespread. The effects result in the loss of EFH over a large area and would result in a loss of function of the habitat to support fisheries and invertebrate populations resulting in a substantial decline in fisheries or invertebrate populations that rely upon that habitat.

Duration: Short-term impacts occur during all or part of alternative implementation; long-term impacts extend beyond implementation of the alternative.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to the existing failed dams along the marl ridge that would be directly affected by the proposed actions; however, impacts to EFH in the expanded area of analysis in the greater Cape Sable area are also discussed, and include the estuarine habitat including the salt marshes and mangroves, seagrass beds, hard bottom areas, and sand/soft bottom areas.

3.6.2.3 Impacts of the Alternatives

Alternative A (No-Action)

1) Analysis. Leaving the existing sheetpiles in the East Cape Extension and Homestead canals where they are today and allowing the channels to continue to widen through natural erosional processes would fail to accomplish goals of the NPS and the USFWS, which are to improve fish and wildlife habitat, and prevent motorized vessel entry into Cape Sable wilderness in order to preserve its habitats.

Without rehabilitating the dam, saltwater would continue to encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas, which serve as EFH for many federally regulated species. The marshes beyond the canals would continue to collapse. Motorized boaters would continue to illegally access the Marjory Stoneman Douglas Wilderness Area, thus further deteriorating the quality of the habitats.

The continuation of saltwater intrusion, sedimentation in Lake Ingraham from the existing tidal flushing, and loss of freshwater through the breached dam would result in long-term minor to moderate adverse effects to EFH.

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). Marine resources and EFH 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 marine resources and EFH 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 marine resources and EFH 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, respectively.

3) Conclusion. Under Alternative A, no construction would take place and current conditions and processes would continue. However, taking no action to address the issues associated with the failed sheetpile dams on the East Cape Extension and Homestead canals would only

prolong anthropomorphic impacts on erosional processes within the canals and the greater Cape Sable area. Alternative A would produce long-term minor to moderate adverse impacts on EFH. Consequently, there would not be an impairment of marine resources and EFH as a result of Alternative A.

Action Alternative C (Repair in Place)

1) Analysis. Direct permanent impacts of 0.064 acres (approximately 2,800 square feet) and 0.068 acres (approximately 2,970 square feet) within surface waters of the East Cape Extension and Homestead canals, respectively, would occur as result of implementing Alternative C, thus affecting a small area of non-vegetated bottom habitat which might constitute EFH for some of the species listed above. 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. However, the area of non-vegetated bottom affected by the proposed project is relatively small compared to the area of other suitable habitats available to these species in the vicinity of the proposed project. These disturbances might also have indirect effects on federally managed species through the loss of benthic prey species found in the non-vegetated bottom habitats. Most of these prey species, however, are expected to re-colonize the affected area within a few seasons following construction. Populations of fish and invertebrates in the wetlands behind the dam would not become isolated, since there are multiple natural channels through the Buttonwood Embankment that provide access to Lake Ingraham and Florida Bay. In addition to the above, approximately 0.002 acres (90 square feet) of permanent shading impacts to 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 resources are known to exist within these waterways, this new shading impact is negligible. Also, floating mooring buoys would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. 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 resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

Construction activities that disturb the bottom are also likely to re-suspend sediments, temporarily increasing turbidity in the estuarine/marine water column. Temporarily elevated levels of suspended sediment would have an adverse effect on federally managed species including species avoidance of the impact area, minor physiological effects (such as abrasion of surface membranes and interference with respiratory functions - fine particulate material would clog or damage sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities.), and indirect effects related to the temporary reduction of light (such as reducing the photic zone and interference with feeding of visually oriented predators - if light penetration is reduced substantially, macrophyte growth may be decreased which would, in turn, impact the organisms dependent upon them for food and cover). However, most of the sediments suspended by the proposed project are expected to settle within or near the impact area shortly after installation is complete, resulting in only minor, temporary impacts to EFH or federally managed species.

Due to the space limitations in the work area at both dam sites, a designated work zone has 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 Extension canal just south of the work zone and along the Homestead canal just west of the work zone. 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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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/suspended soil resulting from the dredging operation, as well as the work within both canals, 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. Thus, no additional mitigation is anticipated for this temporary impact.

The rehabilitated 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 that may constitute EFH for some of the species listed above. The dams would also improve the habitat for fish and invertebrates within Lake Ingraham due to the decrease of the deposition rates. The rehabilitated dams would: limit the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through the East Cape Extension and Homestead canals and reduce freshwater loss from freshwater and brackish marshes through the East Cape Extension and Homestead canals. The reduction of saltwater intrusion and loss of freshwater through the breached dams would result in long-term beneficial effects to EFH.

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). Marine resources and EFH 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 marine resources and EFH 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 marine resources and EFH 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, respectively.

3) Conclusion. Alternative C would result in some short-term, minor unavoidable adverse impacts to habitats designated as EFH for several federally managed species. This includes temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations; no long-term adverse EFH impacts are anticipated. EFH and other marine resources would benefit from improved hydrologic conditions and reduced saltwater intrusion. Alternative C would result in short-term minor adverse effects and long-term beneficial impacts to EFH. Alternative C would not result in the impairment of EFH resources or values.

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

1) Analysis. The relocation of the previous dam structure to a narrower more suitable site that is in better alignment with the marl ridge under this alternative would affect a larger area than under Alternative C, of non-vegetated bottom habitat, which might constitute EFH for some of the species listed above. Alternative D would result in filling of approximately 0.178 acres (7,743 square feet) for the East Cape Extension canal and 0.152 acres (6,660 square feet) for the Homestead canal. Alternative G would result in filling of approximately 0.590 acres (25,719 square feet) for the East Cape Extension canal and 0.450 acres (19,6201 square feet) for the Homestead canal. These filling impacts are a direct result of the placement of the new sheetpile and earthen fill, and riprap for the new plug, stabilization, and armoring. Also, 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 Chapter 2 of this document for further details).These disturbances might also have indirect effects on federally managed species through the loss of benthic prey species found in the non-vegetated bottom habitats. In addition to the above, approximately 0.002 acres (90 square feet) of permanent shading impacts to 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 resources are known to exist within these waterways,

this new shading impact is negligible. Also, floating mooring buoys would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. 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 resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

Populations of fish and invertebrates in the wetlands behind the dam would not become isolated, since there are multiple natural channels through the Buttonwood Embankment that provide access to Lake Ingraham and Florida Bay. The rehabilitated 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 that may constitute EFH for some of the species listed above. The dams would also improve the habitat for fish and invertebrates within Lake Ingraham due to the decrease of the deposition rates. The rehabilitated dams would: limit the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through the East Cape Extension and Homestead canals and reduce freshwater loss from freshwater and brackish marshes through the East Cape Extension and Homestead canals. The reduction of saltwater intrusion and loss of freshwater through the breached dams would result in long-term beneficial effects to EFH.

Dredging would also be required for construction of either Alternative D or G and the operation would be the same as described for Alternative C. No adverse impacts to protected marine resources are anticipated to occur as a result.

The small loss of habitat through either Alternative D or G would be permanent (long-term), but minor. The reduction of saltwater intrusion and loss of freshwater through the breached dams, and the reduction of illegal motorized boaters would result in long-term beneficial effects to EFH.

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). Marine resources and EFH 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 marine resources and EFH 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 marine resources and EFH 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, respectively.

3) Conclusion. This project would result in some long-term minor unavoidable adverse impacts to habitats designated as EFH for several federally managed species. This includes a small loss

of habitat, and temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations. Alternative D or G would result in short-term minor adverse effects and long-term beneficial impacts to EFH. Alternative D or G would not result in the impairment of EFH resources or values.

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

1) Analysis. These alternatives provide a construction option for the Homestead canal that allows for further avoidance and minimization of impacts to protected resources from Alternatives D and G through the use of geotubes in place of sheetpile allowing for the avoidance of dredging a 52-foot wide by approximately 8,320 feet long navigational channel through Lake Ingraham. The implementation of these alternatives would affect a larger area than under Alternative C, of non-vegetated bottom habitat, which might constitute EFH for some of the species listed above. Alternative D1 would result in filling of approximately 0.239 acres (10,413 square feet) within the Homestead canal. Alternative G1 would result in filling of approximately 0.542 acres (23,614 square feet) within the Homestead canal. These filling impacts are a direct result of the placement of the geotubes and fill, riprap for the new plug, and canal bank stabilization. Also, as mentioned in the analysis for Alternatives D and G, above, 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) with implementation of either of these modified alternatives (Alternatives D1 and G1). Since canal access would be limited for Alternatives D1 and G1, a helicopter would be used to import suitable fill material from an offsite staging area (to be chosen by the awarded contractor). The material would be dropped within the limits of the area to be filled and graded using small equipment and manual labor. Prior to filling, all BMP's would be employed to avoid impacts to adjacent wetlands. The resulting higher elevation would help to facilitate the restoration of the marl ridge as a natural hydrologic barrier at this location, as mentioned above. These disturbances might also have indirect effects on federally managed species through the loss of benthic prey species found in the non-vegetated bottom habitats. In addition to the above, approximately 0.002 acres (90 square feet) of permanent shading impacts to 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 resources are known to exist within these waterways, this new shading impact is negligible. Also, floating mooring buoys would be installed downstream (towards Lake Ingraham) of the dam structure for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. 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 resources are known to exist within these waterways, the impacts associated with installation of the moorings would be localized, negligible, adverse, and long-term.

Dredging would also be required for construction of either Alternative D or G and the operation is the same as described for Alternative C. No adverse impacts to protected marine resources are anticipated to occur as a result.

The rehabilitated dam 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 that may constitute EFH for some of the species listed above. The dam would also improve the habitat for fish and invertebrates within Lake Ingraham due to the decrease of the deposition rates. The rehabilitated dam would: limit the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through the Homestead canal and reduce freshwater loss from freshwater and brackish marshes through the

Homestead canal. The reduction of saltwater intrusion and loss of freshwater through the breached dam would result in long-term beneficial effects to EFH.

Populations of fish and invertebrates in the wetlands behind the dam would not become isolated, since there are multiple natural channels through the Buttonwood Embankment that provide access to Lake Ingraham and Florida Bay. The small loss of habitat through the plug placement would be permanent (long-term), but minor. The reduction of saltwater intrusion and loss of freshwater through the breached dam, and the reduction of illegal motorized boaters would result in long-term beneficial effects to EFH.

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). Marine resources and EFH 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 marine resources and EFH 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 marine resources and EFH 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, respectively.

3) Conclusion. This project would result in some long-term minor unavoidable adverse impacts to habitats designated as EFH for several federally managed species. This includes a small loss of habitat, temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations. Alternative D1 or Alternative G1 would result in short-term minor adverse effects and long-term beneficial impacts to EFH. Alternative D1 or Alternative G1 would not result in the impairment of EFH resources or values.

3.7 Special Status Species

3.7.1 Affected Environment

This section provides a summary of the federally-listed threatened and endangered species (T&E) and state-listed/species of special concern found at Everglades National Park that may occur in the Cape Sable study area, with emphasis on those species in the primary project area. The following references were consulted for incorporation of applicable information: Everglades National Park; the Draft South Florida and Caribbean Parks Exotic Plant Management Plan and Draft EIS; Section 7, Endangered Species Act (ESA) consultation with the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NOAA-NMFS); USFWS Endangered Species Web site; USFWS Critical

Habitat Portal; NOAA-NMFS, Office of Protected Resources Web site; the Florida Fish and Wildlife Commission Web site; and the Florida Department of Agriculture and Consumer Services (FDACS) Web site.

Animals and plants federally classified as endangered or threatened are protected under the Endangered Species Act (ESA) of 1973, as amended. According to the Endangered Species Act of 1973, "endangered species" means any plant and animal species in danger of extinction throughout all or a substantial part of its range. A "threatened species" is any species likely to become an endangered species in the foreseeable future throughout all or a substantial part of its range. "Proposed Species" are species of animal or plant proposed in the Federal Register to be listed under Section 4 of the ESA. "Candidate Species" are species for which the USFWS and NOAA-NMFS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA. Everglades National Park provides habitat for a number of federally-listed threatened and endangered animal species, including candidate species.

No specific information is available on the occurrence of federally-listed plant species within the study area. Prior to implementation of any construction, a site survey for these species would be conducted by a qualified botanist. If federally-listed plant species are determined to be directly impacted by the preferred alternative, consultation with the USFWS would occur.

Federally-listed threatened and endangered animal species having the potential to occur in and around the project study area are described in Table 3.15. (Note – the bald eagle (*Haliaeetus leucocephalus*) was delisted in 2007).

Table 3.15 – Federally Listed Threatened and Endangered Species with Potential to Occur in the Cape Sable Area

Common Name	Scientific Name	Federal Status	Designated Critical Habitat in Park
Mammals			
Florida panther	*Puma concolor coryi*	Endangered	No federally designated critical habitat
West Indian manatee	*Trichechus manatus*	Endangered	Portions of Everglades National Park are within federally designated critical habitat. Cape Sable is not within critical habitat.
Fish			
Smalltooth sawfish	*Pristis pectinata*	Endangered	No current federally designated critical habitat. Portions of Everglades National Park are within proposed critical habitat including the Cape Sable project area
Reptiles			
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	No designated critical habitat in Everglades National Park
Green sea turtle	*Chelonia mydas*	Endangered	No designated critical habitat in Everglades National Park
Kemp's Ridley sea turtle	*Lepidochelys kempii*	Endangered	No designated critical habitat in Everglades National Park
Atlantic leatherback sea turtle	*Dermochelys coriacea*	Endangered	No designated critical habitat in Everglades National Park
Loggerhead sea turtle	*Caretta caretta*	Threatened	No federally designated critical habitat

Common Name	Scientific Name	Federal Status	Designated Critical Habitat in Park
American crocodile	*Crocodylus acutus*	Threatened	Portions of Everglades National Park are within designated critical habitat, including the Cape Sable project area
Eastern indigo snake	*Drymarchon corais couperi*	Threatened	No federally designated critical habitat
Birds			
Wood stork	*Mycteria americana*	Endangered	No federally designated critical habitat

Sources: NPS 2007, NPS 2009.

American Crocodile

The American crocodile is greenish-grey in color across the back with white or yellowish undersides (Van Meter 1992; Hamilton 1999). Their backs are covered with rigid bony scales while their bellies are smooth in texture (Van Meter 1992). The snout of an American crocodile is narrow and tapered and the jaws contain about 66 teeth, with the fourth tooth on the lower side of the jaw visible when the mouth is closed (Van Meter 1992; Hamilton 1999). In the Florida population of *C. acutus*, males would reach a maximum size of 4.6 meters in length while females range from 2.5 to 3.9 meters (Van Meter 1992). 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). The number of eggs in a nest ranges from 20 to over 60. 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, some of which exists within Everglades National Park, 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 location in the Cape Sable area. One hundred eight 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). Threats to American crocodiles include loss of habitat (destruction of coastal mangroves and beach development), poaching, and excessive nest predation.

Florida Panther

The Florida panther is a large, pale brown or buff cat with white underparts and tail tip. Mature males weigh between 100 - 150 pounds and would reach 7 feet from nose to tip of tail. Females are smaller – from 50 - 100 pounds and up to 6 feet in length. They subsist on mammalian prey consisting of white-tailed deer, wild hogs, and raccoon and, in some areas, small game. A panther's home range covers 20 to over 450 square miles, with a historic range from eastern Texas through the southeastern states. The only known self-sustaining population occurs in south Florida, generally within the Big Cypress Swamp region. It is estimated that less than 120 individuals of this subspecies remain in the wild population. The Florida panther population primarily utilizes 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.

West Indian Manatee

The West Indian manatee is a fully aquatic herbivorous mammal. 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 manatee occurs in the park's marine and estuarine systems, and spends about 5 hours a day feeding. Submerged aquatic vegetation, such as seagrasses, is a major component of the manatee diet, and although manatees appear to tolerate marine and hypersaline conditions, they are most frequently found in fresh or brackish waters. Changes in freshwater flow on salinity patterns, submerged vegetation, and the overall quality of the foraging habitat in Florida Bay and elsewhere in the park are, along with water temperature, important influences on the distribution and abundance of manatees in the area. Increases in salinity are generally considered to result in less favorable conditions for manatees, although manatees move freely through a wide range of salinities. Manatees may or may not need freshwater to survive, but are frequently reported drinking freshwater from natural sources as well as hoses, sewage outfalls, and culverts in marine and estuarine areas. 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.

Wood Stork

The wood stork is a large, long-legged wading bird, standing about 50 inches tall, with a wingspan over 60 inches. It has white plumage and a short, black tail. Their bill is black, thick at the base, and curved. Their U.S. range consists of parts of Florida, Georgia, and South Carolina. 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). Wood storks use thermal drafts for soaring, and may travel 80 miles from nest to feeding areas. These birds eat small fish, and probe with their bills for their food in shallow water no more than about 10 inches deep. Highly

social, these birds nest in large rookeries and feed in flocks. They are long-lived and first breed at 4 years old. In South Florida nesting occurs as early as October, with young leaving the nest in February or March. 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. The decline in wood stork populations is attributed mostly to loss of habitat by destruction of wetlands and control of flows that created the Everglades. 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.

Eastern Indigo Snake

The Eastern Indigo snake is a large, non-poisonous snake that may reach up to eight feet in length. The snake gets its name from its shiny, blue-black color. Its diet consists mainly of other snakes, amphibians, small mammals, and occasionally birds and sea turtles. The species occurs throughout Florida and along the coastal plain of Georgia. 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. The decline in populations is attributed to loss of habitat to agriculture, and also collecting for the pet trade. The species has suffered from mortality during gassing of gopher tortoise burrows for rattlesnake collection. Little is known about the specific habits and niche of the Eastern indigo snake in the park. The species is generally found in and near hardwood hammocks, and has shown no preference for disturbed sites. Eastern indigo snake protection measures have also established by the USFWS for all construction activities.

Loggerhead Sea Turtle

Loggerhead sea turtles are characterized by a large head with blunt jaws. The shell and flippers are a reddish-brown color. The loggerhead is widely distributed within its range. Loggerhead sea turtles typically occur over the continental shelf and in bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers, but have been found as far as 500 miles offshore (NMFS and USFWS 1991b). Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Nesting season extends from about May to August. 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. After hatching, juvenile loggerheads move directly to sea and often float in masses of sargassum (NMFS and USFWS, 1991b). Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; disease; and incidental take from channel dredging and commercial trawling, longline, and gill net fisheries. These sea turtles nest on the beaches at Cape Sable, but no suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA NMFS for all construction projects.

Leatherback Sea Turtle

Leatherback sea turtles are the largest, deepest diving, and most migratory and wide ranging of all sea turtles. An adult would reach four to eight feet in length and 500 to 2,000 pounds in weight. Nesting occurs from February to July with sites located from Georgia to the U.S. Virgin

Islands. Of all the sea turtles, the leatherback spends the most time in the open ocean, 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). Adult females require sandy nesting beaches backed with vegetation and sloped sufficiently so the crawl to dry sand is not too far. The preferred beaches have proximity to deep water and generally rough seas. 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). Threats to this species include loss or degradation of nesting habitat from coastal development; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; and watercraft strikes. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA NMFS for all construction projects.

Atlantic Hawksbill Sea Turtle

The Atlantic hawksbill turtle is a small to medium-sized animal having an elongated oval shell, a relatively small head with a distinctive hawk-like beak, and flippers with two claws. General coloration is brown with numerous splashes of yellow, orange, or reddish-brown on the shell. In most locations nesting occurs sometime between April and November. In contrast to all other sea turtle species, hawksbills nest in low densities on scattered small beaches. Hawksbills inhabit coastal reefs, bays, rocky areas, estuaries, and lagoons and are generally found at depths of 70 feet or less. They are seldom seen in water deeper than 65 feet. Juveniles, subadults, and adults typically forage on coral reefs, although hawksbills may also occupy other hard-bottom communities and occasionally mangrove-fringed bays. Hatchlings are often found floating in masses of sea plants, and nesting may occur on almost any undisturbed deep-sand beach in the tropics. Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA NMFS for all construction projects.

Kemp's Ridley Sea Turtle

One of the smallest of the sea turtles, adult Kemp's Ridley turtles reach about two feet in length and weigh up to 100 pounds. The adult Kemp's Ridley has an oval shell that is almost as wide as it is long and is usually olive-gray in color. Nesting occurs off the Tamaulipas and Veracruz coasts of Mexico. The Kemp's Ridley sea turtles 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). The preferred sections of nesting beach are backed up by extensive swamps or large bodies of open water having seasonal, narrow ocean connections. The decline of this species is primarily due to human activities, including the direct harvest of adults and eggs and incidental capture in commercial fishing operations. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA NMFS for all construction projects.

Green Sea Turtle

The green turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, single-clawed flippers, and its color varies. The nesting season is roughly June to September. The green sea 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. 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. Green sea turtle foraging areas in the southeastern United States include shallow coastal and estuarine waters with an abundance of macroalgae or seagrass. Green sea turtles have strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches. Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA NMFS for all construction projects.

Smalltooth Sawfish

In the US, smalltooth sawfish are generally shallow water marine fish of inshore bars, mangrove edges, and seagrass beds. Very small individuals maintain fidelity to shallow mud or sand banks in water less than one foot deep for extensive periods of time (Simpfendorfer 2003). Small and very small individuals also utilize red mangrove prop root habitats especially during periods of high tide (Simpfendorfer and Wiley 2005). Smalltooth sawfish are generally found in shallow water throughout the northern Gulf of Mexico, individuals have been reported to seasonally migrate northward along the Atlantic seaboard. Adult smalltooth sawfish are opportunistic feeders and subsist chiefly on whatever small schooling fish may be abundant locally, such as mullets and clupeids, and various crustacean species. They are generally 2 feet long at birth and may grow to a length of 18 feet. Over the past century, the population of smalltooth sawfish has been reduced by fishing, habitat alteration, and habitat degradation. Currently smalltooth sawfish are only found with regularity in the lagoons, bays, mangroves, and nearshore reefs in south Florida from Charlotte Harbor to Florida Bay (Simpfendorfer and Wiley 2005). Within the Cape Sable project area, they are occasionally caught and released by anglers, especially in Lake Ingraham. The U.S. distinct population of smalltooth sawfish was listed as endangered under the Federal Endangered Species Act on April 1, 2003 (68 FR 15674). On November 20, 2008 (73 FR 70290) NOAA NMFS proposed to designate critical habitat for the U.S. distinct population of smalltooth sawfish. The proposed critical habitat is located in southwest Florida and consists of two units: the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/Everglades Unit which includes the Cape Sable project area. Smalltooth sawfish protection measures have been created by NOAA NMFS for all in-water construction projects to ensure that no adverse impacts to this species would occur.

State-Listed Species

The state of Florida lists a variety of plant and animal species as endangered, threatened, species of special concern, or commercially exploited. The state defines these species under the Florida Endangered and Threatened Species Act as follows:

Animals

- A threatened species is any species of fish and wildlife naturally occurring in Florida which may not be in immediate danger of extinction, but which exists in such small populations as to become endangered if it is subjected to increased stress as a result of further modification of its environment.

- Endangered species are defined as any species of fish and wildlife naturally occurring in Florida, whose prospects of survival are in jeopardy due to modification or loss of habitat; over utilization for commercial, sporting, scientific, or educational purposes; disease; predation; inadequacy of regulatory mechanisms; or other natural or manmade factors affecting its continued existence.

Plants

- "Threatened plants" means species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in such number as to cause them to be endangered.
- "Endangered plants" means species of plants native to the state that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue, and includes all species determined to be endangered or threatened pursuant to the federal Endangered Species Act of 1973, as amended,

The Florida Fish and Wildlife Conservation Commission list includes 118 animal species (FWC 2006); and the Florida Department of Agriculture and Consumer Services (FDACS) identifies 542 plant species (421 endangered species, 113 threatened species, and eight commercially-exploited species (FDACS 2003). Of the state-listed species, 20 plant species and 10 animal species have the potential to occur in the study area (Tables 3.13 and 3.14).

Currently, no specific information is available on the occurrence of state-listed plant species in the study area. Prior to implementation of any construction under any alternatives, a site survey for these species would be conducted by a qualified botanist. However, according to the FDACS, statutory protection of State-listed plants is not applicable if the clearing of land is performed by a public agency when acting in the performance of its obligation to provide service to the public (Section 581.185(8) Florida Statutes). However, individual State-listed plant species would be avoided wherever possible during construction using best management practices.

Table 3.16 – State-Listed Plant Species with Potential to Occur in the Cape Sable Canals Dam Study Area

Common Name	Scientific Name	State Status	Species Information
Triangle cactus, barbwire cactus	*Acanthocereus tetragonus*	Threatened	Coastal berms maritime hammocks, beaches
Golden leather fern	*Acrostichum aureum*	Threatened	Tidal marshes, mangrove swamps
Cinnamon bark	*Canella winterana*	Endangered	Coastal hammocks
Powdery strap airplant	*Catopsis berteroniana*	Endangered	Tidal swamps
Cowhorn orchid	*Cyrtopodium punctatum*	Endangered	Buttonwood forests, cypress prairie, cypress domes
Dollar orchid	*Encyclia boothiana var. erythronioides*	Endangered	Coastal buttonwood forests, tidal swamps
Florida butterfly orchid	*Encyclia tampensis*	Commercially Exploited	Mangrove swamps, cypress swamps, hardwood swamps
White fenrose	*Kosteletzkya depressa*	Endangered	Borders of mangrove swamps, coastal hammocks
Wild dilly	*Manilkara jaimiqui* subsp. *Emarginata*	Threatened	Coastal berms, coastal hammocks

Florida mayten	*Maytenus phyllanthoides*	Threatened	Margins of coastal hammocks along the ecotone with mangrove swamps and salt marshes
Mule ear oncidium	*Oncidium undulatum*	Endangered	Coastal hammocks and buttonwood forests
Erect pricklypear	*Opuntia stricta*	Threatened	Coastal berms, tidal marsh
Coral panicum	*Paspalidium chapmanii*	Endangered	Coastal berms, shell mounds, hammocks, prairies, bay shores, cleared areas
Swampbush	*Pavonia paludicola*	Endangered	Coastal mangrove forests
Florida Keys blackbead	*Pithecellobium keyense*	Threatened	Coastal berms, sand dunes adjacent to beaches, hammocks, pinelands
Reflexed wild-pine, northern needleleaf	*Tillandsia balbisiana*	Threatened	Moist forests, swamps, pinelands, hammocks
Banded wild-pine, twisted airplant	*Tillandsia flexuosa*	Threatened	Mangrove swamps, tidal marsh, shell ridges and mounds, coastal berms, hammocks, pinelands
Giant wild-pine, giant airplant	*Tillandsia utriculata*	Endangered	Pinelands, coastal hammocks, cypress swamps, coastal buttonwood forests
Wormvine orchid	*Vanilla barbellata*	Endangered	Coastal buttonwood forests, coastal hammocks

Sources: NPS 2007, NPS 2009, IRC 2009, Coile 2003

Table 3.17 – State-Listed Animal Species with Potential to Occur in the Cape Sable Canals Dam Study Area

Common Name	Scientific Name	State Status
Brown pelican	*Pelecanus occidentalis*	Species of Special Concern
The brown pelican is a large, brown water bird, with a white head and neck. Young brown pelicans have a gray head and neck and white underbelly. This species would reach up to 8 pounds and have a wingspan of over 7 feet. Brown pelicans nest in colonies on coastal islands. Nests are generally built in mangrove trees, but ground nests are also used. The eastern subspecies nests in early spring or summer. Brown pelicans are commonly observed in the Lake Ingraham area.		
Little blue heron	*Egretta caerula*	Species of Special Concern
The little blue heron is a wading bird found along the Atlantic coast from Massachusetts to Florida, and is most abundant along the Gulf of Mexico. This species ranges up to 30 inches in height and would have a wingspread of 3 feet. Adults have a purple head and neck, with a slate-gray body. The long neck is held in an "S" curve at rest and in flight. Young are all white, with a blue bill and green legs. Little blue herons feed during the day on fish, reptiles, crustaceans, and insects. The long bill is used to jab and eat the prey. Little blue herons are common throughout the Cape sable area.		
Reddish egret	*Egretta rufescens*	Species of Special Concern
The reddish egret, which is rare in the Cape Sable region, breeds in scattered areas along the Gulf of Mexico, the Caribbean and west Mexico. Reddish egrets stand about 30 inches tall and have a wingspan of 4-feet. The head and neck are chestnut, and head plumes may give a golden-maned appearance. The reddish egret nests exclusively on coastal islands, usually building the nest of sticks, 10 to 20 feet above the ground in bushes or trees. In the early 1900s, most populations of reddish egrets were exterminated by plume hunters. Protection from plume hunters has helped reestablish and stabilize populations, but development pressure, and coastal dredging and filling are still a threat to their survival.		
Snowy egret	*Egretta thula*	Species of Special Concern
The snowy egret is a small white heron, about 2 feet tall, with a 3 foot wingspan, and weighing just		

Common Name	Scientific Name	State Status
less than 1 pound. This species is distinguished by a black bill and legs, with yellow feet. Both male and female have the same coloring. Snowy egrets breed in shared colonies in salt marshes, ponds and shallow bays. Prey includes aquatic organisms and insects, such as shrimp, fish, frogs, and insects. They forage by walking slowly or standing motionless and striking at the prey. The species was reduced from common to rare by 20th century plume hunting. Snowy egrets are extremely common throughout the cape sable area.		
Tricolored heron	*Egretta tricolor*	Species of Special Concern
The tricolored heron is a wading bird found from Massachusetts to the Gulf Coast. Reaching 30 inches in height, and weighing up to one pound, its slate-gray plumage is complemented by a white belly and a white chin stripe. During most of the year, the bill is yellow with a black tip and its legs are yellow. During mating season the bill turns bright blue and the legs are bright pink. Its diet consists primarily of fish, but may include small reptiles, amphibians, insects, and crustaceans. This species usually breeds in brackish and saltwater coastal areas, in mixed colonies with other herons. Nests are close to the ground. Tricolored herons are common throughout the Cape sable area		
White ibis	*Eudocimus albus*	Species of Special Concern
The white ibis is a medium-sized wading bird. Its feathers are entirely white, except for dark wing tips. The face is bare and pink, blending into a long, curved bill. It has long pink legs and webbed toes. Barriers, marshes, coastal islands and inland lakes are the preferred habitat and nesting sites. White ibis probe for aquatic crustaceans and insects using their bill. White ibis are common in the study area.		
Roseate spoonbill	*Ajaia ajaja*	Species of Special Concern
Roseate spoonbills are found in the coastal marshes, mudflats, and mangrove keys from Florida to coastal Texas. These large wading birds stand almost 3 feet tall and have a wingspan in excess of 4 feet. The term ‘Roseate’ refers to the brilliant pink color of the adult bird. This species is often found in small groups with other wading birds. To feed, roseate spoonbills immerse their bill tips in water and swing their heads from side to side. Their diet consists of small fishes, crustaceans, mollusks, slugs and aquatic insects. Roseate spoonbills often nest in rookeries with herons, ibis, and other wading birds. They construct their nests of sticks, in trees or bushes, 5 - 15 feet off the ground. Early in the 20th century, this species was depleted by the feather trade. Since protective laws have been enacted in Florida, their numbers have risen. Roseate spoonbills commonly utilize the tidal flats for feeding in the vicinity of the study area. They nest on islands in Florida Bay.		
Osprey	*Pandion haliaetus*	Species of Special Concern
The project area is inhabited by the osprey, a large, long-winged raptor that is brown above, white below, and has a white head with a dark eye stripe. The wing has a distinctive bend at the "wrist" and from a distance would resemble a gull. This species ranges from Alaska eastward to Newfoundland and south to Arizona and Florida. They winter along the Gulf Coast and in California. They inhabit large lakes, rivers, and coastal areas where suitable nesting sites would be found. They fish by hovering over the water; when they sight prey then dive talons first into the water. The nest is a mass of sticks and debris placed in large living or dead trees and man-made structures. Low nesting sites are common, particularly in mangrove swamps. Most broods include 2 – 4 chicks. Due to the use of pesticides, osprey populations declined dramatically in the 1950s and 1960s, but since then the species has recovered substantially.		
White crowned pigeon	*Columba leucophala*	Species of Special Concern
In south Florida, the white-crowned pigeon is common in summer and uncommon in winter. The birds feed in hardwoods, such as fig, pigeon plum, poisonwood, and other fruit-bearing trees. Birds nesting on small keys in Florida Bay fly to the mainland or upper Keys daily to feed. They are permanent residents in Florida, but their population numbers are highly seasonal. White-crowned pigeons begin returning to Florida in large numbers in April and the numbers increase until early June. Populations remain high through the summer with the seasonal peak occurring in September when many juvenile birds are flying. Most white-crowned pigeons leave Florida between mid-September and mid-October. Most white-crowned pigeons from Florida Bay and the Upper Keys fly to the Bahamas. More than half of the Florida population nests in Florida Bay, in Everglades National Park. Nesting on mainland Florida is rare. Nesting requires mangrove covered islands that are free of raccoons and human disturbance. White-crowned pigeons require an abundant supply of fruit. The plants that produce this		

Common Name	Scientific Name	State Status
fruit are found in a number of habitats on the southern tip of the peninsula and in tropical hardwood forests on the Florida Keys. Fruiting hardwoods in the vicinity of the study area may provide potential feeding habitat for white-crowned pigeons. These areas are found on artificial high ground such as the slightly-elevated relict soil banks adjacent to the canals.		
Mangrove rivulus	*Rivuulus marmoratus*	Species of Special Concern
The mangrove rivulus is a small fish (5 inches in Florida with a killifish body shape, tubular nostrils, and rounded caudal fin. The head and body are maroon to dark brown with dark spots and speckling on the body, particularly the sides, and the caudal fin often has a large dark spot surrounded by a band of yellow. This fish is primarily a saltwater or brackish water species that would tolerate salinities of 0-60 parts per thousand. It is found in estuarine habitats such as tidal rivers, tidal marshes, mangrove wetlands, and tidal flats. Within the Everglades, this fish occurs in stagnant seasonal ponds over marly muck, sloughs, and mosquito ditches within mangrove habitats. Burrows of crabs are often utilized during the dry season. Important predators include wood storks and other fish, and possibly mangrove salt marsh snakes.		

NPS 2007, FFWCC 2004, Hipp et all 2001

3.7.2 Environmental Consequences

3.7.2.1 Guiding Regulations and Policies

The primary regulation governing this topic is the Endangered Species Act (ESA), 16 USC § 1531-1543.

The purpose of the ESA is to conserve "the ecosystem upon which endangered and threatened species depend" and to conserve and recover listed species. The ESA is a comprehensive wildlife conservation law administered by the Department of Interior's U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration-Fisheries. This act mandates that all federal agencies protect listed species and preserve their habitats.

The state of Florida also has regulations for the protection of threatened and endangered species. The Florida Endangered and Threatened Species Act (Title 28, Florida Statutes, Natural Resources Conservation, Reclamation, and Use, Chapter 372, Wildlife, Section 372.072) is the primary regulation in the state, and sets the policy to conserve and wisely manage these resources, as well as provide for research and management to conserve and protect these species as a natural resource. This act also emphasizes coordination with other state agencies, and outlines annual reporting requirements as well the development of specific biological goals for manatees.

The Endangered Species Protection Act (Florida Statutes Section 372.0725) prohibits the intentional wounding or killing of any fish or wildlife species designated by the Florida Game and Freshwater Fish Commission as "endangered", "threatened" or of "special concern". This prohibition also extends to the intentional destruction of the nests or eggs of any such species.

The protection of endangered, threatened, or "commercially exploited" plants is addressed in the Preservation of Native Flora of Florida Act (Florida Statutes Section 581.185). Commercially exploited plants are defined as species native to the state which are subject to being removed in substantial numbers from native habitats in the state and sold or transported for sale. This act sets the policy for the state of Florida relating to these species, and includes several prohibitions covering the "willful destroying or harvesting" of such plants. It also contains an exemption for agricultural and silvicultural uses.

Section 4.4.2.3 of the NPS *Management Policies 2006* provides specific guidance for management of threatened or endangered plants and animals. These policies dictate that the NPS would survey for, protect, and strive to recover all species native to national park system

units that are listed under the Endangered Species Act. The NPS would fully meet its obligations under the NPS Organic Act and the Endangered Species Act to both proactively conserve listed species and prevent detrimental effects on these species. This section also states that the National Park Service would inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible. In addition, the Service would inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and would manage them to maintain their natural distribution and abundance.

3.7.2.2 Assumptions, Methodology, and Intensity Thresholds

The USFWS and NOAA-NMFS guidance for implementing Section 7 consultation under the Endangered Species Act uses the following terminology to assess impacts to listed species[7]:

"No Effect" – the appropriate conclusion when the action agency determines its proposed action would not affect a listed species or designated critical habitat." (p. xvi)

"**Is not likely to adversely affect"** – the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects on the species. **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect or evaluate insignificant effects; or (2) expect discountable effects to occur." (pp. xv-xvi)

"**Is likely to adversely affect"** – the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. An "is likely to adversely affect" determination requires the initiation of Section 7 consultation." (p. xv)

Based on these impact levels, the thresholds for threatened and endangered species are as follows:

Negligible: There would be no observable or measurable impacts to federally-listed species, their habitats, or the natural processes sustaining them in the proposed project area. This impact intensity would equate to a determination of "no effect" under Section 7 of the Endangered Species Act.

Minor: Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat. This impact intensity would equate to a determination of "not likely to adversely affect" under Section 7 of the Endangered Species Act.

Moderate: Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat; however, the level of impact would not

[7] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.

result in a physical injury, mortality, or extirpation from the park. This impact intensity would equate to a determination of “likely to adversely affect” under Section 7 of the Endangered Species Act.

Major: Individuals may suffer physical injury or mortality or populations may be extirpated from the park. This impact intensity would equate to a determination of “likely to adversely affect” under Section 7 of the Endangered Species Act.

3.7.2.3 Impacts of the Alternatives

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 federally listed endangered, threatened, or special concern species and their habitat that currently occur 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 only prolong the anthropomorphic impacts on erosional processes within this canal and the greater Cape Sable area. These processes would continue to act at current or potentially increasing rates. Related erosion and channel widening would be expected to continue. The southern interior wetlands would continue to suffer marsh collapse as a result of the daily influx of tidal waters moving through the canal. Peat soil would continue to be lost and wetlands would continue to convert to a mosaic of mangrove communities with saline open water habitats. Other impacts specific to Federally-listed species are discussed below.

American Crocodile

Related erosion and channel widening would result in loss of potential American crocodile nesting habitat along the banks of the canals. Increasing salinity in the southern interior wetlands would adversely affect juvenile American crocodiles which require low salinity levels for survival. Though adults are tolerant of a wide salinity range because of their ability to osmoregulate, juvenile crocodiles lack this ability (Mazzotti 1989). Hatchling crocodiles are particularly susceptible to osmoregulatory stress and may need to have brackish to freshwater available at least once per week to increase growth (Mazzotti *et al.* 1986). Therefore, the no action alternative is likely to adversely effect the American crocodile.

Florida Panther

The East Cape Extension and Homestead canal project areas are located outside of the Panther Preservation Areas and the Panther Conservation Area. 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, Alternative A is not anticipated to adversely effect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the Florida Panther.

West Indian Manatee

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. There is a minimal potential for manatees to become injured by the existing failed sheetpile dams from the strong current in the East Cape Extension and Homestead canals. However, the existing conditions allow the manatees passage through the canals. This alternative should have minimal adverse impact on manatees. Therefore, the no action alternative may affect, but is not likely to adversely affect, manatees.

Wood Stork

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 area. 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. This alternative would have minimal impact on existing wood stork foraging habitat. Therefore, the no action alternative may affect, but is not likely to adversely affect, the wood stork.

Eastern Indigo Snake

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. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the eastern indigo snake.

Loggerhead Sea Turtle

Loggerhead turtle 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. Because the project location lacks the preferred habitat, there is a relatively low potential for this project to impact the loggerhead turtle. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the Loggerhead sea turtle.

Leatherback Sea Turtle

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. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the leatherback sea turtle. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the Leatherback sea turtle.

Atlantic Hawksbill Sea Turtle

No suitable nesting habitat for the Atlantic hawksbill turtle exists within the project limits. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the Atlantic hawksbill sea turtle. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the Atlantic hawksbill sea turtle.

Kemp's Ridley Sea Turtle

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. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the Kemp's Ridley sea turtle. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the Kemp's Ridley sea turtle.

Green Sea Turtle

Green sea turtles might temporarily utilize habitat within the project area; however, no suitable nesting habitat exists within the project limits. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the green sea turtle. Implementation of Alternative A is not anticipated to adversely affect this species. Therefore, Alternative A may affect, but is not likely to adversely affect, the green sea turtle.

Smalltooth Sawfish

The potential exists for the smalltooth sawfish to occur within the project area. Without rehabilitating the dam, saltwater would continue to encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas, which serve as (proposed) critical habitat for this species. The marshes beyond the canals would continue to collapse. Motorized boaters would continue to illegally access the Marjory Stoneman Douglas Wilderness Area, thus further deteriorating the quality of the habitat. The continuation of saltwater intrusion, sedimentation in Lake Ingraham from the existing tidal flushing, and loss of freshwater through the breached dam would degrade habitat for the smalltooth sawfish. Therefore, the no action alternative may adversely effect this species.

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). Special status species 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 special status species 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 species status species 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, respectively.

3) Conclusion. Under Alternative A, no construction would take place and current conditions/processes would continue. There would be no direct adverse effect from construction on federally listed endangered, threatened, or special concern species and their habitat that currently occur 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 only prolong the anthropomorphic impacts on erosional processes within these canals and the greater Cape Sable area. Alternative A may potentially result in long-term moderate to major adverse impacts to the American crocodile and smalltooth sawfish and their habitat within the local project area, and would not likely adversely affect other special status species.. Consequently, if no action is taken, there would be no impairment of special status species as a result of Alternative A. Table 3.18 below summarizes the individual effects to Federally-listed species.

Table 3.18 – Effect Determinations for Federally-Listed Species (Alternative A)

Species	Effect Determination	Reason
Florida panther	May affect, not likely to adversely affect	The proposed project is not located within the PCA, and no evidence was found of panthers inhabiting the wetlands of the Cape Sable area.
American crocodile	Likely to adversely affect	Loss of nesting habitat along the banks of the canal; Increasing salinity in the interior wetlands.
West Indian manatee	May affect, not likely to adversely effect	Potential for injury by the existing sheetpile structure; open passage is maintained.
Wood stork	May affect, not likely to adversely affect	One active nesting colony located approximately 14.2 miles northeast of the project area, within the CFA.
Eastern Indigo snake	May affect, not likely to adversely affect	Project location lacks the preferred snake habitat.
Atlantic hawksbill sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area.
Green sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area.
Kemp's Ridley sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area.
Leatherback sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area.
Loggerhead sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area.
Smalltooth sawfish	May adversely affect	Degradation of habitat from continued sedimentation.

Section 7 consultation with the USFWS and the NMFS would be initiated with the submittal of this EA to these agencies by NPS for review during the public comment period. Initial comments have been received from the NMFS through the Public Scoping process. These comments are summarized in Chapter 4 of this document.

Action Alternatives D1 (New 100' Plug - Geotubes) and G1 (New 430' Plug - Geotubes)[8]

1) Analysis. Impacts to the majority of Federally-listed species and impacts to species of special concern as a whole would be nearly identical with the implementation of Alternative D1 or Alternative G1. All Federally-listed species would benefit from improved hydrologic conditions and reduced saltwater intrusion. However, potential impacts to the American crocodile would differ slightly between action alternatives due to the difference in fill volume.

Alternative D1 and Alternative G1 involve the use of geotubes. Geotubes are large tubular sand bags that are filled in place by pumping sand through a pipe from a barge. Two sets of geotubes would be placed in the canal about 100 feet/430 feet, respectively, apart, the intervening area filled with pumped-in sand, and the plug planted with native vegetation to reduce erosion. Graded rip-rap would also have to be placed for reinforcement and to prevent erosion in the geotube area. One of the main advantages of this alternative would be that dredging of Lake Ingraham for access would not be required. However, fill material would have to be hydraulically

[8] For the purpose of impacts analysis relating to the dredging/no dredging option, the alternatives in the section have been discussed out of the original order and Alternatives D1 and G1 are discussed first.

pumped in from an area within Lake Ingraham. Additionally, the rip-rap would have to be transported to the dam site from Lake Ingraham staging area using a helicopter. Due to these unique construction methods, dredging would not be required as part of the construction activities and impacts to species of special concern would be limited. Impacts to each individual Federally-listed species are discussed below.

American Crocodile

The implementation of Alternative D1 or Alternative G1 would have a relatively similar impact on the American crocodile with the exception of the amount of nesting habitat that is destroyed or constructed within the area of the dam structure. Alternative D1 or Alternative G1 would result in a disturbance and alteration of 100 and 430 linear feet of crocodile nesting habitat on each side of the canal adjacent to the proposed plug. However, this habitat would be replaced with similar habitat within the fill area along the plug. Additionally, by constructing the dam structure associated with Alternative D1 or Alternative G1, saltwater intrusion into the interior marshes would be limited to high water events during which the entire marl ridge is overtopped. The limitation of saltwater intrusion would have a beneficial long-term effect on juvenile crocodile growth and survival. Short-term impacts from construction would be mitigated by the timeframe for construction. 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 and the beneficial effects from construction of a dam structure, the proposed project may effect but is not likely to adversely effect the American crocodile.

Florida Panther

The project area is located outside of the Panther Preservation Areas and the Panther Conservation Area. 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 implementation of Alternative D1 or Alternative G1 is not anticipated to have an adverse effect on this species. Therefore, Alternative D1 or G1 may affect, but is not likely to adversely affect, the Florida panther.

West Indian Manatee

The potential for manatees exists within the 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 (http://myfwc.com/docs/WildlifeHabitats/Manatee_Std CondIn_waterWork .pdf) 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. Manatees would not become trapped in the wetlands behind the dam since there are multiple natural channels through the Buttonwood Embankment that provide access to Lake Ingraham and Florida Bay. The reduction of illegal motorized boaters would result in long-term beneficial effects to the manatees, reducing the risk of injury or death due to boat collisions. Therefore, the implementation of Alternative D1 or Alternative G1 may effect but is not likely to adversely effect this species.

Wood Stork

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 the implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the wood stork.

Eastern Indigo Snake

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 the implementation of Alternative D1 or Alternative G1 may affect, but is not likely to adversely affect the Eastern indigo snake.

Loggerhead Sea Turtle

Loggerhead turtle 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. Construction activities would 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 NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the loggerhead turtle.

Leatherback Sea Turtle

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 would 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 NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the leatherback turtle.

Atlantic Hawksbill Sea Turtle

No suitable nesting habitat for the Atlantic Hawksbill turtle exists within the project limits. Construction activities would 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 NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the Atlantic hawksbill turtle.

Kemp's Ridley Sea Turtle

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 would 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 NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the Kemp's Ridley turtle.

Green Sea Turtle

Green turtles might temporarily utilize habitat within the project area; however, no suitable nesting habitat exists within the project limits. Construction activities would 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 NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the green turtle.

Smalltooth Sawfish

The potential exists for the smalltooth sawfish to occur within the project area and construction activities would 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. The rehabilitated dam 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 that may constitute critical habitat for the sawfish. The dam would also improve the habitat within Lake Ingraham due to the decrease of the deposition rates. The rehabilitated dam would: limit the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through the Homestead canal and reduce freshwater loss from freshwater and brackish marshes through the Homestead canal. The reduction of saltwater intrusion and loss of freshwater through the breached dam would result in long-term beneficial effects to the proposed smalltooth sawfish critical habitat.

Populations of fish in the wetlands behind the dam would not become isolated, since there are multiple natural channels through the Buttonwood Embankment that provide access to Lake Ingraham and Florida Bay. These channels would also permit access to and from nursery habitat that may exist behind the dam as well. The small loss of habitat through the plug

placement would be permanent (long-term), but minor. The reduction of saltwater intrusion and loss of freshwater through the breached dam, and the reduction of illegal motorized boaters would result in long-term beneficial effects to the proposed smalltooth sawfish critical habitat.

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. Smalltooth sawfish protection measures generated by NOAA NMFS 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 implementation of Alternative D1 or Alternative G1 may affect but is not likely to adversely affect the smalltooth sawfish.

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). Special status species 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 special status species 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 species status species would be limited only to those direct and indirect impacts resulting from implementation of Alternative D1 or Alternative G1. For more information on cumulative impacts and the determinations of negligible impacts see Section 1.4.5 and Section 3.2.3, respectively.

3) Conclusion. Impacts to the majority of Federally-listed species and impacts to species of special concern as a whole would be nearly identical with the implementation of Alternative D1 or Alternative G1. All Federally-listed species would benefit from improved hydrologic conditions and reduced saltwater intrusion. Additionally, Table 3.19 below summarizes the effects to individual Federally-listed species. Consequently, if Alternative D1 or Alternative G1 is implemented, long-term beneficial effects would occur and, there would be no impairment to species of special concern.

Table 3.19 – Effect Determinations for Federally-Listed Species (Alternatives D1 and G1)

Species	Effect Determination	Reason
Florida panther	No adverse affect	The proposed project is not located within the PCA, and no evidence was found of panthers inhabiting the wetlands of the Cape Sable area.
American crocodile	May affect, not likely to adversely affect	Preserves nesting habitat along canal banks; Improves juvenile habitat by restoring natural salinity regimes in interior wetlands.

Species	Effect Determination	Reason
West Indian manatee	May affect, not likely to adversely affect	FFWCC standard protection measures would be implemented prior to and during all in-water construction activities.
Wood stork	May affect, not likely to adversely affect	One active nesting colony located approximately 14.2 miles northeast of the project area, within the CFA.
Eastern Indigo snake	May affect, not likely to adversely affect	Project location lacks the preferred snake habitat; USFWS standard protection measures during construction.
Atlantic hawksbill sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities.
Green sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities.
Kemp's Ridley sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities.
Leatherback sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities.
Loggerhead sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities.
Smalltooth sawfish	May affect, not likely to adversely affect	NOAA NMFS standard protection measures would be implemented during all in-water construction activities.

Section 7 consultation with the USFWS and the NMFS would be initiated with the submittal of this EA to these agencies by NPS for review during the public comment period. Initial comments have been received from the NMFS through the Public Scoping process. These comments are summarized in Chapter 4 of this document.

Action Alternatives C (Repair in Place), D (New 100' Plug), and G (New Marl Ridge Plug)

1) Analysis. Impacts from the implementation of Alternatives C, D, and G would be identical to the impacts from Alternative D1 and Alternative G1 with the exception of additional impacts resulting from dredging activities required for construction of the sheetpile dams. Impacts to the majority of Federally-listed species and impacts to species of special concern as a whole would be nearly identical with the implementation of Alternatives C, D, or G. All Federally-listed species would benefit from improved hydrologic conditions and reduced saltwater intrusion. However, impacts to the American crocodile would differ slightly between action alternatives due to the difference in fill volume, as discussed in the analysis of Alternative D1 and Alternative G1.

In order to transport construction materials to the Homestead canal dam site, dredging of Lake Ingraham would be required. Due to the space limitations in the work area at both dam sites, a designated work zone has 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 Extension canal just south of the work zone and along the Homestead canal just west of the work zone. 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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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). Turbidity/suspended soil resulting from the dredging operation, as well as the work within both canals, 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.). Therefore, negligible to minor adverse impacts beyond the construction footprint would occur as a result of turbidity/suspended soils. The turbidity barriers would be removed at the work areas in the canals once turbidity has subsided following construction completion of the dams. 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. 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.

Construction impacts to species of special concern from dredging activities would consist mainly of habitat impacts. Dredging activities uproot seagrasses and directly impact shell bottom, wetlands, or shallow soft bottom features. Conversion of shallow habitat to deep habitat from dredging activities results in loss of valuable nursery habitat and alters natural circulation patterns. Dredging would also degrade habitat by increasing turbidity and sedimentation. These habitat impacts are expected to temporarily affect the West Indian manatee, smalltooth sawfish, and all of the Federally-listed sea turtles. Per discussions with the regulatory agencies, the backfilling of the channel upon completion of construction would serve as mitigation for the temporary impacts. Thus, no mitigation is warranted for this temporary impact.

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). Special status species 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 special status species would occur as a result of combining the cumulative projects with the actions contained in Alternative C, D, or G because the effects of the cumulative projects would be negligible. Impacts to species status species would be limited only to those direct and indirect impacts resulting from implementation of Alternative C, 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, respectively.

3) Conclusion. Impacts to the majority of Federally-listed species and impacts to species of special concern as a whole would be nearly identical with the implementation of Alternative C, D, or G. All Federally-listed species would benefit from improved hydrologic conditions and reduced saltwater intrusion. Additionally, Table 3.20 below summarizes the effects to individual Federally-listed species. Consequently, if Alternative C, D, or G is implemented, long-term beneficial effects would occur and, there would be no impairment to species of special concern.

Table 3.20 – Effect Determinations for Federally-Listed Species (Alternatives C, D, and G)

Species	Effect Determination	Reason
Florida panther	May affect, not likely to adversely affect	The proposed project is not located within the PCA, and no evidence was found of panthers inhabiting the wetlands of the Cape Sable area.
American crocodile	May affect, not likely to adversely affect	Loss of potential nesting habitat along the banks of the canal; Increasing salinity in the interior wetlands.
West Indian manatee	May affect, not likely to adversely affect	FFWCC standard protection measures would be implemented prior to and during all in-water construction activities; Dredging impacts are temporary.
Wood stork	May affect, not likely to adversely affect	One active nesting colony located approximately 14.2 miles northeast of the project area, within the CFA.
Eastern Indigo snake	May affect, not likely to adversely affect	Project location lacks the preferred snake habitat; USFWS standard protection measures during construction.
Atlantic hawksbill sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and

Species	Effect Determination	Reason
		during all in-water construction activities; Dredging impacts are temporary.
Green sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities; Dredging impacts are temporary.
Kemp's Ridley sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities; Dredging impacts are temporary.
Leatherback sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities; Dredging impacts are temporary.
Loggerhead sea turtle	May affect, not likely to adversely affect	No suitable nesting habitat within the project area; NOAA NMFS standard protection measures would be implemented prior to and during all in-water construction activities; Dredging impacts are temporary.
Smalltooth sawfish	May affect, not likely to adversely affect	NOAA NMFS standard protection measures would be implemented during all in-water construction activities; Dredging impacts are temporary.

Section 7 consultation with the USFWS and the NMFS would be initiated with the submittal of this EA to these agencies by NPS for review during the public comment period. Initial comments have been received from the NMFS through the Public Scoping process. These comments are summarized in Chapter 4 of this document.

3.8 Wilderness

3.8.1 Affected Environment

Everglades National Park is one of the most unusual wilderness areas on the continent. It is the largest remaining subtropical wilderness in the United States, and its abundant wildlife includes rare and endangered species, such as the Florida panther and West Indian manatee. It has been designated an International Biosphere Reserve, a World Heritage Site, and a Wetland of International Importance, in recognition of its significance to all the peoples of the world (NPS 2004).

Approximately 1,296,500 acres (524,686 hectares) of wilderness was designated at Everglades National Park by Congress on November 10, 1978. The park also contains approximately 81,900 acres (33,144 hectares) of potential wilderness; combined, these areas represent about 86 percent of the total park area (NPS 2006a). The East Everglades Expansion Area, a 109,600 acre addition to the northeast area of the park in 1989, is currently being evaluated for wilderness characteristics in the park's *General Management Plan*. Areas excluded from wilderness designation include existing developed areas, marine surface waters, and an area in the park reserved for tribal use (NPS 2006b).

The park manages its wilderness areas, including potential wilderness, in accordance with the Wilderness Act so that the areas retain their "primeval character and influence, without permanent improvements or human habitation" (16 USC § 1131). Development in the park is limited to areas of existing services, utilities, and infrastructure. Management activities occurring in wilderness are associated with fire management, exotic plant management, and research and educational activities. Visitors to the park are encouraged to follow "Leave No Trace" principles when recreating in wilderness to ensure its protection and to maximize the visitor's wilderness experience. These principles include traveling and camping on durable surfaces, disposing of waste properly, leaving wilderness resources as they are found, minimizing campfire impacts, respecting wildlife, and being considerate to other visitors (NPS 2006a).

Visitor use and experience of the wilderness area surrounding the area is somewhat limited, due to the difficult access and/or inhospitable nature of the wilderness areas. The submerged bottom wilderness of the waters surrounding the project area is generally not "experienced" by visitors, because snorkelers and divers do not frequent this area due to the shallow nature of it, the presence of crocodiles, and the turbidity of the water. However, the Homestead and East Cape Extension canals serve as an entry to the Everglades backcountry, thus the submerged wilderness serves as a key ecological component for the health of the park's marine areas.

3.8.2 Environmental Consequences

3.8.2.1 Guiding Regulations and Policies

The Wilderness Act, passed on September 3, 1964, established a National Wilderness Preservation System, "administered for the use and enjoyment of the American people in such manner as would leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness" (16 USC § 1131). Lands identified as being suitable for wilderness designation, wilderness study areas, proposed wilderness, and recommended wilderness (including potential wilderness) must also be managed to preserve their wilderness character and values in the same manner as "designated wilderness" until Congress has acted on the recommendations (NPS 1999).

Wilderness regulations at the park include (NPS nd2):

- It is illegal to feed wildlife. Backcountry sites are shared with alligators, sea turtles, nesting birds and other wildlife that would be observed but not disturbed;
- All plants, animals, and artifacts are protected and should not be collected or disturbed. Cutting mangroves or other vegetation in any manner is prohibited. Unoccupied shells may be gathered, up to one quart per person;
- Pets are not permitted at backcountry campsites, beaches, or ashore anywhere in the backcountry. Pets would disrupt feeding, nesting, and mating activities of wildlife;
- All vessels must conform to Coast Guard regulations. Boaters are required to obey all posted signs regarding closures, no wake zones, etc. Caution should be used in posted manatee areas, and all travel in these areas should be at idle speed;
- Operation of generators, chain saws, and other portable motors is prohibited at wilderness sites;
- Ground fires are not permitted at ground sites and chickees. Ground fires are only allowed at beach sites (except islands in Florida Bay), where they must be below the

average high tide line. Only dead *and* down wood is allowed for fires, which should be cleaned up after use. Backpacking stoves are recommended, as wood is often wet;

- Possession of weapons is prohibited;
- All keys (islands) in Florida Bay are closed to landing, except Bradley Key (open sunrise to sunset) and those designated as campsites. In Florida Bay, the mainland from Terrapin Point to U.S. 1 is closed to landing;
- All sleep-aboard vessels in the wilderness must be anchored out of sight of chickees and 1/4 mile from other occupied sites;
- State fishing licenses in fresh and salt water are required, and species and size requirements are enforced;
- Food should not be left unattended, and should be stored in a secure compartment aboard a vessel or in a hard-sided cooler (not foam); and
- All trash must be removed from the backcountry. Burying it or disposing of it in toilets is prohibited. Toilets should be used for human waste only where provided. International laws prohibit dumping trash at sea.

Within the NPS, Director's Order #41 addresses wilderness issues. The purpose of Director's Order #41 is to provide accountability, consistency, and continuity within the NPS' wilderness management program, and to otherwise guide Service-wide efforts in meeting the letter and spirit of the 1964 Wilderness Act. In addition, NPS *Management Policies 2006* are based on provisions of the 1916 NPS Organic Act, the 1964 Wilderness Act, and legislation establishing individual units of the national park system.

Chapter 6 of the NPS *Management Policies 2006* addresses all aspects of wilderness management and preservation of designated wilderness in units of the NPS. This chapter requires that wilderness considerations be integrated into all planning documents to guide the preservation, management, and use of the park's wilderness area and ensure that wilderness is unimpaired for future use and enjoyment as such. According to section 6.1, the purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition and, in accordance with the Wilderness Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use.

3.8.2.2 Assumptions, Methodology, and Intensity Thresholds

Section 6.2.1 of the NPS *Management Policies 2006*, dictates that NPS lands would be considered eligible for wilderness if they are at least 5,000 acres or of sufficient size to make practicable their preservation and use in an unimpaired condition, and if they possess the following characteristics (as identified in the Wilderness Act):

- The earth and its community of life are untrammeled by humans, where humans are visitors and do not remain;
- The area is undeveloped and retains its primeval character and influence without permanent improvements or human habitation;
- The area generally appears to have been affected primarily by the forces of nature, with the imprint of humans' work substantially unnoticeable;
- The area is protected and managed so as to preserve its natural conditions; and

- The area offers outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Per section 6.3.4.3, in evaluating environmental impacts, this EA considers (1) wilderness characteristics and values, including the primeval character and influence of the wilderness; (2) the preservation of natural conditions (including the lack of man-made noise); and (3) assurances there would be outstanding opportunities for solitude, that the public would be provided with a primitive and unconfined type of recreational experience, and wilderness would be preserved and used in an unimpaired condition. Mitigation measures considered in this analysis are listed in Chapter 2 and are mentioned in the analysis where appropriate.

The thresholds for the intensity of an impact are defined for wilderness as follows:

Negligible: There would be little or no effect on wilderness character or wilderness experience. The effect on wilderness character would be so small that it would not be of any measurable or perceptible consequence.

Minor: An effect on one or more attributes of wilderness character and wilderness experience and associated values would occur; it would be slightly detectable and highly localized.

Moderate: Attributes of wilderness character and wilderness experience would be affected in a substantial way in a single distinct area, or the impact would affect multiple areas but would not be permanent and would not affect an entire visitor season.

Major: One or more attributes of wilderness character and wilderness experience would be affected substantially across more than one distinct area of the park on either a permanent or frequent but temporary basis during the course of an entire visitor season.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to the existing failed dams along the marl ridge that would be directly affected by the proposed actions; however, impacts to wilderness in the expanded area of analysis in the greater Cape Sable area originating at the dam sites are also discussed.

3.8.2.3 Impacts of the Alternatives

Alternative A (No-Action)

1) Analysis. Leaving the existing sheetpiles in the East Cape Extension and Homestead canals where they are today and allowing the channels to continue to widen through natural erosional processes would fail to accomplish goals of the NPS and the USFWS, which are to improve fish and wildlife habitat, and prevent motorized vessel entry into Cape Sable wilderness in order to preserve its character.

Without rehabilitating the dams, saltwater would continue to encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas, which serve as habitat for the American Crocodile, various wading birds and other species. The marshes beyond the canals would continue to collapse. Motorized boaters would continue to illegally access the Marjory Stoneman Douglas Wilderness Area, thus not allowing for opportunities of solitude, and thus, not providing for the full enjoyment of the park as wilderness. These effects would result in long-term moderate to major adverse impacts to wilderness. Increased visitor use extending into the surrounding waters, islands, and backcountry areas would also result in indirect minor adverse impacts due to noise and human presence, trampling, etc.

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). Wilderness 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 wilderness 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 wilderness 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, respectively.

3) Conclusion. Because the East Cape Extension and Homestead canals are located in a wilderness area, Alternative A (no action) would have long-term moderate indirect adverse effects on the wilderness character. Alternative A would produce moderate to major adverse impacts on wilderness. Consequently, there would be no impairment of wilderness as a result of Alternative A.

Action Alternative C (Repair in Place)

1) Analysis. Because the project area is within wilderness, there would be negligible to minor effects under Alternative C from repairing the existing steel sheetpile walls by extending them further inland, reestablishing the canal banks with earthen fill, and placing riprap along the canal banks. The implementation of BMPs to reduce the noise from these activities would limit the potential effects on wilderness character and experience (such as solitude) in the immediately surrounding wilderness. As a result, Alternative C would have negligible, short-term indirect effects on wilderness during these activities.

The necessary fill to re-establish the canal banks and for the riprap would be loaded onto barges and delivered to the project site. The transport of materials to the Homestead canal dam site would require dredging a suitable access channel within Lake Ingraham (as described under Section 3.6.2.3, Alternative C) to access the work area. Erosion control measures, as well as the spill prevention, control and countermeasure procedures, discussed for water resources would minimize the potential effects of erosion, sedimentation, and discharge of other pollutants during construction activities.

Due to the space limitations in the work area at both dam sites, a designated work zone has 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 Extension canal just south of the work zone and along the Homestead canal just west of the work zone. 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 would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would 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 would 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). Turbidity/suspended soil resulting from the dredging operation, as well as the work within both canals, 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.). Therefore, negligible to minor adverse impacts beyond the construction footprint would occur as a result of turbidity/suspended soils. The turbidity barriers would be removed at the work areas in the canals once turbidity has subsided following construction completion of the dams. 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. 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. Short-term moderate impacts would occur during construction only, due to restrictions in access.

The repair of the existing breached dams would prevent illegal motorized boat entry into the wilderness area. However, the potential exists for vandals to attempt to alter the banks of the canals beyond the outer edges of the dam, enabling for illegal motorized boats, but the installation of the deflector wingwalls and riprap would mitigate this type of activity. By preventing illegal boaters from accessing the wilderness, an immediate long term benefit would occur by providing an increased wilderness experience, minimizing noise, and human presence.

By rehabilitating the dams, saltwater would encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas only during high water events, thus minimizing substantially the adverse effects of saltwater intrusion into the wilderness. Thus, the implementation of Alternative C would result in long-term beneficial effects.

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). Wilderness 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 wilderness 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 wilderness 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, respectively.

3) Conclusion. Because the East Cape Extension and Homestead canals are located in a wilderness area, Alternative C would have long-term indirect beneficial effects on the wilderness character. Alternative C would produce long-term beneficial impacts on wilderness. Consequently, there would be no impairment of wilderness as a result of alternative C.

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

1) Analysis. Because the project area is within wilderness, there would be negligible to minor effects under Alternative D or G from extracting and relocating the previous dam structure to a narrower more suitable site that is in better alignment with the marl ridge (see Figures 2.3 and 2.4 in Section 2.1.1 depicting the location of the preferred alternatives along the highest elevation points of the marl ridge for each of the canals). The implementation of BMPs to reduce the noise from these activities would limit the potential effects on wilderness character and experience (such as solitude) in the immediately surrounding wilderness. As a result, Alternative D or G would have negligible, short-term indirect effects on wilderness during these activities. However, long-term minor adverse effects would result from the larger structures.

The necessary fill for the riprap and plugs would be loaded onto barges and delivered to the project site. The transport of materials to the Homestead canal dam site would require dredging a suitable access channel (as described under Section 3.6.2.3, Alternative C) within Lake Ingraham to access the work area. Erosion control measures, as well as the spill prevention, control and countermeasure procedures, discussed for water resources would minimize the potential effects of erosion, sedimentation, and discharge of other pollutants during construction activities. As a result, these activities would have short-term, negligible indirect adverse impacts on submerged wilderness. Also, 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 Chapter 2 of this document for further details). The resulting higher elevation would help to facilitate the restoration of the marl ridge as a natural hydrologic barrier at this location. 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.

Dredging would also be required for construction of either Alternative D or G and the operation would be the same as described for Alternative C. No long-term adverse impacts to the submerged wilderness are anticipated to occur as a result, only short-term restrictions in access during construction.

The extraction and relocation of the existing breached dam would prevent illegal motorized boat entry into the wilderness area. The potential for vandals to attempt to alter the banks of the canals beyond the outer edges of the dams, enabling for illegal motorized boats is greatly reduced in these alternatives because the plug would be constructed by installing two sheetpile

walls, and the intervening area would be filled with selected material from an off-site location and then planted with native vegetation to reduce erosion. By preventing illegal boaters from accessing the wilderness, an immediate long term benefit would occur by providing an increased wilderness experience, minimizing noise, and human presence.

By rehabilitating the dams, saltwater would encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas only during extreme high water events, thus further minimizing the adverse effects of saltwater intrusion into the wilderness as compared to Alternative C. Thus, the implementation of Alternative D or G would result in long-term beneficial effects.

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). Wilderness 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 wilderness 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 wilderness 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, respectively

3) Conclusion. Because the East Cape Extension and Homestead canals are located in a wilderness area, Alternative D or G would have long-term indirect beneficial effects on the wilderness character. Alternative D or G would produce beneficial impacts on wilderness. Consequently, there would be no impairment of wilderness as a result of Alternative D or G.

Action Alternatives D1 (New 100' Geotube Plug) and G1 (New Marl Ridge Plug)

1) Analysis. Dredging of an access channel in Lake Ingraham would not be required with these modified alternatives. With these alternatives, geotubes would supplant the proposed sheetpile walls associated with Alternative D or G. These alternatives include the extraction and removal of the existing free-standing sheetpile walls (previous dam structures). In addition, two sets of geotubes would be placed in each canal. The geotubes would be filled with sand or other suitable material. The riprap would require aerial transportation to the Homestead canal work area from the Lake Ingraham staging area (approximately 1.3 miles each way) using a helicopter. Because the project area is within wilderness, there would be minor effects under Alternative D1 or Alternative G1 from extracting the previous dam structure, and from the transportation of the riprap via helicopter. The implementation of BMPs to reduce the noise from these activities would limit the potential effects on wilderness character and experience (such as solitude) in the immediately surrounding wilderness. As a result, Alternative D1 or Alternative G1 would have minor, short-term effects on the wilderness experience during these activities. However, long-term minor adverse effects would result from the larger structures.

Erosion control measures, as well as the spill prevention, control and countermeasure procedures, discussed for water resources would minimize the potential effects of erosion, sedimentation, and discharge of other pollutants during construction activities. As a result, these activities would have short-term, negligible indirect adverse impacts on the wilderness. Also, as mentioned in the analysis for Alternatives D and G, above, 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) with implementation of either of these modified alternatives (Alternatives D1 and G1). Since canal access would be limited for Alternatives D1 and G1, a helicopter would be used to import suitable fill material from an offsite staging area (to be chosen by the awarded contractor). The material would be dropped within the limits of the area to be filled and graded using small equipment and manual labor. Prior to filling, all BMP's would be employed to avoid impacts to adjacent wetlands. The resulting higher elevation would help to facilitate the restoration of the marl ridge as a natural hydrologic barrier at this location. 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.

By rehabilitating the dam, saltwater would continue to encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas only during extreme high water events. Thus, the implementation of Alternative D1 or G1 would result in long-term beneficial effects.

The extraction and relocation of the existing breached dam would prevent illegal motorized boat entry into the wilderness area. The potential for vandals to attempt to alter the banks of the canal beyond the outer edges of the dam, enabling for illegal motorized boats is greatly reduced in this alternative. By preventing illegal boaters from accessing the wilderness, an immediate long-term benefit would occur by providing an increased wilderness experience, minimizing noise, and human presence.

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). Wilderness 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 wilderness 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 wilderness 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, respectively.

3) Conclusion. Alternative D1 or Alternative G1 would have long-term indirect beneficial effects on the wilderness character. Alternative D1 or Alternative G1 would produce beneficial impacts on wilderness. Consequently, there would be no impairment of wilderness as a result of Alternative D1 or Alternative G1.

3.9 Cultural Resources

Under the National Historic Preservation Act, “historic properties” are sites, structures, buildings, districts, and objects that are listed in, or eligible for listing in the National Register of Historic Places. This EA assesses the potential impacts to historic structures and districts.

3.9.1 Affected Environment

Prehistoric American Indians first arrived in South Florida over 12,000 years ago. The Glades cultural period emerged approximately 750 B.C. and continued to about 1500 A.D. Hunters and gatherers from this period build complex shellworks, earthworks, and canoe canals in the dynamic Cape Sable area, taking advantage of the rich ecosystem. Remnants of large sheet middens would still be found along the shoreline of the Cape Sable Beaches. Within the interior marshes, the prehistoric Mud Lake Canal was designated a National Historic Landmark (NHL) on September 20, 2006. The Mud Lake Canal stretches 6.3 kilometers (3.9 miles) across Cape Sable, linking Bear Lake and the waters of Whitewater Bay with Florida Bay, passing through the Bear Lake Mounds National Register Archeological District. The Mud Lake Canal is important because it is the best preserved example of a rare prehistoric engineering feat—a long-distance canoe canal. The property is a rare and well-preserved example of an aboriginal canoe canal, a type of site that is unique to Florida and the Southeast in terms of North American prehistory. The Canal was dug by American Indians and may have been designed to provide safe passage, easy access to aquatic resources, and routes facilitating trade and interaction among tribal groups (Luer 1989; Wheeler 1995). There are a few places where the Mud Lake Canal has been affected by modern, twentieth century construction. The Homestead Canal, built in 1922, crosses the Mud Lake Canal at five places, accounting for small disruptions. The Old Ingraham Highway, the original road from Homestead to Flamingo, crosses the canal, as does the modern park road to Flamingo. Considering the length of the canal, these disturbances are relatively minor and have had little overall effect on the canal feature.

Ponce de Leon was likely the first European to set eyes on Cape Sable during the latter stages of his 1513 voyage. Eight years later he was mortally wounded by native Calusa Indians somewhere in southwest Florida, northwest of Cape Sable. The area was also important during the Seminole Wars. It was here in 1838 that Dr. Henry Perrine was given a grant of land. Unfortunately his plans for a settlement did not materialize due to his untimely death at the hands of Indians. Surgeon General Thomas Lawson explored the Cape in 1838 for the U.S. government where he built Fort Poinsett. In 1856 during the Third Seminole War, Fort Cross was established at Middle Cape. Several attempts were made to settle the area in the 1800s, but environmental conditions unfavorable to agriculture and conflict with Native Americans prevented the success of early white settlement. The U.S. Government transferred much of the land in South Florida to state control in 1850.

The historic Ingraham Highway, Homestead Canal and East Cape Canal are currently proposed for listing in the National Register of Historic Places. The area proposed as the Ingraham Highway Historic District includes the Old Ingraham Highway, Homestead Canal (8MO1906, 8DA11436), and East Cape Extension Canal (8MO1907), and the area that is immediately adjacent to the remaining portions of the historic features (Figure 3.7). The Old Ingraham Highway inside of Everglades National Park is approximately 41 miles long and 37 feet wide in most areas. Beginning at the park property line, the boundary follows Old Ingraham Highway

and Homestead Canal to Bear Lake. Although the highway ends at Bear Lake, Homestead Canal continues to Lake Ingraham, and the National Register boundary follows the right-of-way of the canal to the lake. The boundary also extends south and southeast along the right-of-way of the East Cape canal, which connects the Homestead canal and Lake Ingraham with the Florida Bay. (NPS 2009). The Homestead canal was dredged to use as fill for Old Ingraham Highway, while the East Cape canal was dredged as an effort to drain the lands of Cape Sable for development. Although the plans for Cape Sable's development were never realized, the completion of Ingraham Highway and Homestead Canal provided additional access to more extensive exploration and exploitation of its resources (Tebeau 1963). According to the J.B. McCrary Company, the canal almost doubled the value of potential farm land in the area. The road and its canals only slightly influenced the lives of Cape Sable's residents, and although many agricultural and industrial ventures arose after the road and canals were completed, these enterprises did not last.

In the late 1950s, the NPS began reconstructing part of the Ingraham Highway in order to accommodate visitors to the park, and build a new road that diverged almost half a mile west from the park entrance through the pinelands and across the open freshwater marl prairie to Mahogany Hammock and Sweet Bay Pond, where it connected with the Old Ingraham Highway to Flamingo. Portions of the highway have since been removed by the South Florida Water Management District and the U.S. Army Corps of Engineers to provide improved water flow from north to south, which has benefited wildlife populations and allowed for the restoration of marshes within Taylor Slough. Although a section of this road was removed across Taylor Slough, the State Historic Preservation Officer (SHPO) determined that the project had no adverse effect on the historic highway and did not preclude it from being eligible for listing in the National Register of Historic Places.

Since the completion of the canals, tides and runoff have continually widened the canals. The canals have also changed the shorelines at their mouths, leading to the loss of an estimated 30,000 cubic yards of material. In addition, the canals exposed Lake Ingraham to tidal flows and changed its environment from brackish freshwater to one of high salinity. In the late 1940s, chloride analysis of water samples taken along the Homestead Canal showed that salt water intrusion was occurring. In the late 1950's or early 1960's, the East Cape and Homestead canals were plugged with earthen dams to minimize saltwater intrusion into the formerly freshwater interior marshes behind the marl ridge. However, these dams failed during the late 1980's or early 1990's and were replaced by 20-foot-long sheetpiling dams in 1997. The sheet-pile plugs failed after a few years, possibly due in part to vandalism, which increased erosion of the canal banks. It is important to note that the two failed dams at Homestead and East Cape Canals are not considered historic structures and have not been identified as features contributing to the National Register eligibility of the canals.

There is ambivalence regarding the legacy of these structures (the road and canals) when viewed in the context of their environmental impacts, but portions of the Old Ingraham Highway are still used by visitors and managers to provide access into the vast wetland wilderness of the Park. While the original intent was to drain and develop the area, the structures played a determining role in the establishment of the park. Once the Park was established, it was recognized that in order for the ecosystem to function, the historic linear features would have to be modified. These modifications, too, have historical significance, under the historic themes of conservation and science. Moreover, as these themes continue their evolution, proposed undertakings are consistent with this broad pattern of history.

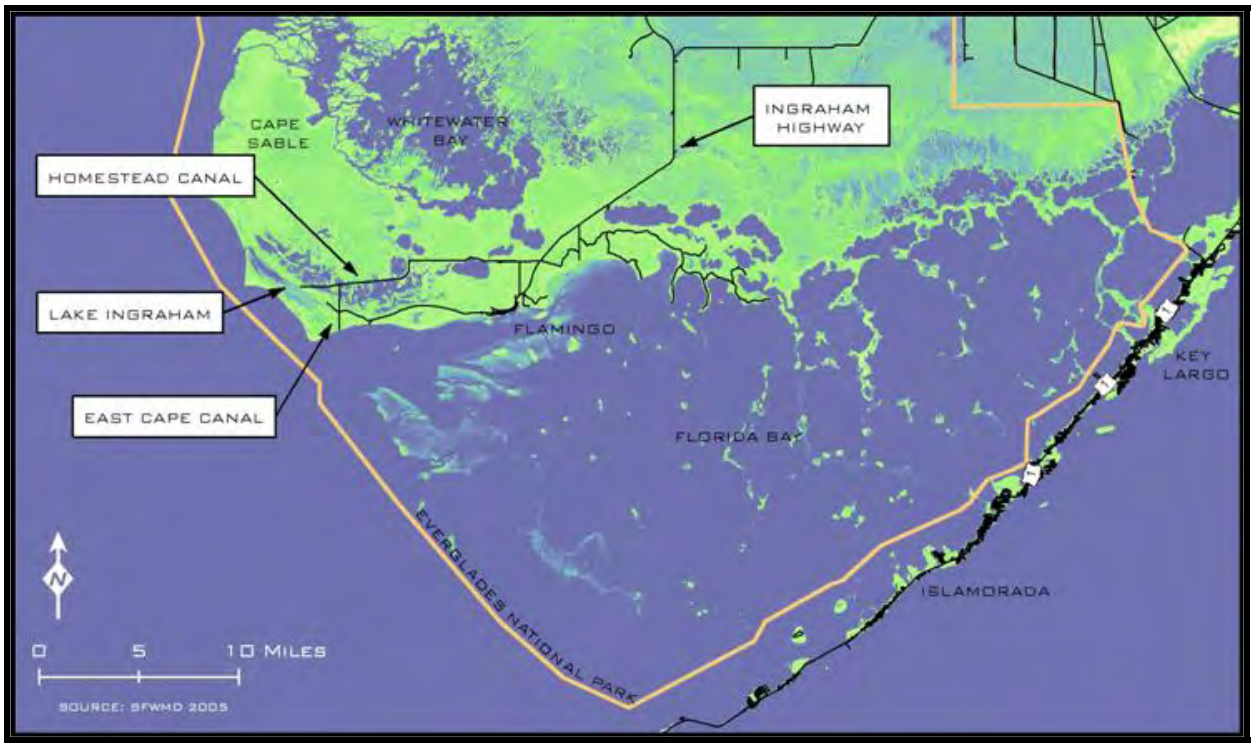


Figure 3.7 – Current Proposals for National Register of Historic Places

3.9.2 Environmental Consequences

3.9.2.1 Guiding Regulations and Policies

The primary act related to cultural resources is the National Historic Preservation Act of 1966, as amended. Section 106 of this act requires federal agencies to consider the effects of their undertakings on properties listed or potentially eligible for listing on the National Register of Historic Places. Other acts and executive orders relevant to this section include:

36 CFR 800 – Protection of Historic Properties. Regulations implementing Section 106 of the National Historic Preservation Act

Executive Order 11593 – Protection and Enhancement of the Cultural Environment

This Executive Order directs federal agencies to support the preservation of cultural properties and to identify and nominate to the NRHP cultural properties in the park and to "exercise caution... to assure that any NPS-owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

Executive Order 13007 – Indian Sacred Sites

Federal agencies shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites on federal lands.

NPS Director's Order 28 and NPS 28

Cultural Resource Management Guideline is intended to aid managers, planners, staff, and cultural resource specialists. It outlines the basic principles and ingredients of a good park cultural resource management program.

NPS Management Policies 2006

Chapter 5, Section 5.3.1 Protection and Preservation of Cultural Resources states that the National Park Service would employ the most effective concepts, techniques, and equipment to protect cultural resources against theft, fire, vandalism, overuse, deterioration, environmental impacts, and other threats without compromising the integrity of the resources. If inadvertent discoveries of human remains are made during the projects, the protocols outlined in the May 2008 Park NAGPRA Plan of Action for *Inadvertent Discoveries, Everglades National Park and Associated Tribes* would be followed.

3.9.2.2 Assumptions, Methodology and Intensity Thresholds

In this EA, impacts to historic structures and districts are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the Council on Environmental Quality that implement NEPA. These impact analyses are intended, however, to comply with the requirements of both NEPA and Section 106 of the National Historic Preservation Act (NHPA). In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 of the NHPA (36 CFR Part 800, Protection of Historic Properties), impacts to historic structures and buildings were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed in or eligible to be listed in the National Register of Historic Places (NRHP); (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the NRHP; and (4) considering ways to avoid, minimize or mitigate adverse effects.

Under the Advisory Council's regulations a determination of either *adverse effect* or *no adverse effect* must also be made for affected, NRHP-eligible cultural resources. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualify it for inclusion in the NRHP, e.g., diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance or be cumulative (36 CFR Part 800.5, *Assessment of Adverse Effects*). A determination of *no adverse effect* means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the NRHP.

CEQ regulations and the National Park Service's Director's Order 12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, e.g., reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. It does not suggest that the level of effect as defined by Section 106 is similarly reduced. Although adverse effects under Section 106 may be mitigated, the effect remains adverse.

A Section 106 summary for historic buildings and districts is included at the end of the impact analysis sections. The Section 106 summary is intended to meet the requirements of Section 106 and addresses the potential effect of the undertaking (implementation of the alternatives) on cultural resources, based upon the criteria of effect and adverse effect found in the Advisory Council's regulations.

The following impact thresholds were used for the types of cultural resources assessed in this EA. Although they are similar, there are some variations:

Historic Structures and Districts

Negligible: Impact(s) would be at the lowest levels of detection - barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Minor: Impact would not affect the character defining features of a NRHP-eligible or listed structure or building. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Moderate: Impact would alter a character defining feature(s) of the structure or building but would not diminish the integrity of the resource to the extent that its NRHP-defining elements are diminished. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Major: Impact would alter a character defining feature(s) of the structure or building, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed in the NRHP. For purposes of Section 106, the determination of effect would be *adverse effect*.

3.9.2.3 Impacts of the Alternatives

Alternative A – No-Action

1) Analysis. The constant movement of water along the Cape has led to the widening of several canals, resulting in a substantial loss of coastal habitat. The expansion of these canals has exacerbated sediment deposition in the cape's open waters and is converting Lake Ingraham into a tidal mud flat. Under Alternative A, the current erosion rate in the East Cape Extension and Homestead canal banks would continue, gradually widening the canals and changing their historic integrity. Alternative A would result in long-term minor to moderate adverse impacts.

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). Cultural resources 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 cultural resources 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 cultural resources 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, respectively.

3) Conclusion. Because there would be a degradation of the current existing conditions, the no action alternative would result in long-term minor to moderate adverse impacts to historic structures and a potential historic district. Alternative A would not produce major adverse impacts on cultural resources. Consequently, there would be no impairment of cultural resources as a result of Alternative A.

Action Alternatives C (Repair in Place), D (New 100' Plug – Marl Ridge Location), and G (New 370'/430' Plug – Marl Ridge Location)

1) Analysis. The implementation of Alternatives C, D or G would contribute to the deceleration of erosional processes in the East Cape Extension and Homestead canals. The construction of Alternative C would not impact the character or function of these historic resources or affect

their historic significance. However, because construction would occur within the overall footprint of the national register-eligible canals, construction would have minor adverse impacts on these historic structures. Alternatives D or G would result in short- and long-term minor to moderate adverse effects from modification of the historic canals (plugs would be located in different locations than the existing failed dam, thus causing a visual intrusions). The NPS would coordinate with the SHPO to ensure that no long-term adverse impacts occur to these structures as a result of construction activities related to dam restoration. The proposed construction measures would stabilize and preserve the historical integrity of the canals (according to The Secretary of the Interior's Standards for the Treatment of Historic Properties, 1995 - please refer to Section 1.2). The action alternatives (C, D or G) would also have long-term beneficial impacts due to the deceleration of erosional processes.

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). Cultural resources 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 cultural resources would occur as a result of combining the cumulative projects with the actions contained in Alternative C, D, or G because the effects of the cumulative projects would be negligible. Impacts to cultural resources would be limited only to those direct and indirect impacts resulting from implementation of Alternative C, 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, respectively.

3) Conclusion. Construction would have minor adverse impacts on the national register-eligible canal, due to the construction occurring within the overall footprint of these historic structures. But, because there would be a deceleration of erosional processes, the action alternatives would result in long-term beneficial impacts to historic structures and a potential historic district. Consequently, there would be no impairment of cultural resources as a result of the implementation of Alternatives C, D or G.

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

1) Analysis. Alternative D1 and Alternative G1 are modifications of Alternatives D and G respectively, and involve installation using geotubes in place of sheetpile walls in the Homestead canal. The implementation of Alternative D1 or Alternative G1 would contribute to the deceleration of erosional processes in the Homestead Canal and would not require dredging for construction activities. The construction of either alternative would not impact the character or function of this historic resource or affect its historic significance. However, because construction would occur within the overall footpring of the national register-eligible canals, construction would have minor adverse impacts on these historic structures. Alternative D1 or Alternative G1 would result in short- and long-term minor adverse effects from modification of the proposed Historic Canals (plug in different location than the existing failed dam). The NPS

would coordinate with the SHPO to ensure that no long-term adverse impacts occur to these structures as a result of construction activities related to dam restoration. The proposed construction measures would stabilize and preserve the historical integrity of the canals (according to The Secretary of the Interior's Standards for the Treatment of Historic Properties, 1995 - please refer to Section 1.2). However, Alternative D1 or Alternative G1 would have long-term beneficial impacts due to the deceleration of erosional processes.

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). Cultural resources 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 cultural resources 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 cultural resources 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, respectively.

3) Conclusion. Construction would have minor adverse impacts on the national register-eligible canal, due to the construction occurring within the overall footprint of these historic structures. But, because there would be a deceleration of erosional processes, Alternative D1 or Alternative G1 would result in long-term beneficial impacts to historic structures and a potential historic district. Consequently, there would be no impairment of cultural resources as a result of the implementation of Alternative D1 or Alternative G1.

3.9.2.4 Section 106 Summary

No archaeological resources have been found to date within the expanded study area. The project area has not been systematically surveyed for archeological resources. However, prior to implementation of the preferred alternative, areas that have not been surveyed that would have ground disturbance in non-disturbed areas would be surveyed and archeological resources avoided. Based on regional surveys, the low lying interior marshes and marl ridge have a low probability of containing archeological resources. The known archeological resources are on the high ground area on the Western coastline of the Cape. A variety of researchers have visited the Cape Sable area to locate and document the historic resources of Cape Sable (Tebeau 1968, Taylor 1985, Paige 1986). Two prehistoric midden sites are located over 8 miles north of the project area. These are the Bear Lake Mounds and Coot Bay Middens. These prehistoric sites were visited and documented as early as 1924. Excavation at the mounds has yielded potsherds, fiber sources, animal bones, and shell fragments. The prehistoric Mud Lake Canal was designated a National Historic Landmark (NHL) on September 20, 2006. The property is a rare and well-preserved example of an aboriginal canoe canal, a

type of site that is unique to Florida and the Southeast in terms of North American prehistory. The site is outside the area of potential impact.

The historic Ingraham Highway, Homestead Canal and East Cape Canal are currently proposed for listing in the National Register of Historic Places. The area proposed as the Ingraham Highway Historic District includes the Old Ingraham Highway, Homestead Canal, and East Cape Extension Canal, and the area that is immediately adjacent to the remaining portions of the historic features. The Homestead canal was dredged to use as fill for Old Ingraham Highway, while the East Cape canal was dredged as an effort to drain the lands of Cape Sable for development. Although the plans for Cape Sable's development were never realized, the completion of Ingraham Highway and Homestead Canal provided additional access to more extensive exploration and exploitation of its resources. While the original intent was to drain and develop the area, the structures played a determining role in the establishment of the park. Once the Park was established, it was recognized that in order for the ecosystem to function, the historic linear features would have to be modified. These modifications, too, have historical significance, under the historic themes of conservation and science. Moreover, as these themes continue their evolution, proposed undertakings are consistent with this broad pattern of history

There are no designated cultural landscapes in the Cape Sable area of Everglades National Park. The history of Everglades National Park includes settlement and the use of waters for fishing for both sustenance and profit by both Native Americans and early settlers to the area. The Miccosukee and Seminole tribes claim the Everglades as a homeland and traditional use area before the park's establishment. Fishing for subsistence and profit has occurred at the park since the early 1900s and may be considered an ethnographic use. However, since the law prohibits commercial fishing, this ethnographic use (commercial fishing) has been terminated. Subsistence fishing would continue but would not be affected by this project. Project actions would not interfere with any other ethnographic uses, and impacts from construction, if any, to ethnographic resources would be negligible. Consultation with tribes, the Florida Division of Historical Resources Bureau of Historic Preservation, and the Advisory Council on Historic Preservation has been initiated in letters dated September 16, 2008 (Appendix B). A copy of this environmental assessment would be forwarded to tribes and the Florida State Historic Preservation Officer for review and comment.

This EA has described existing cultural resource conditions in the project area (including NHRP properties), and evaluated the potential environmental effects of the alternatives. Given these conditions and the mitigation measures, the assessment of effect for all alternatives discussed in this EA would be *no adverse effect*.

3.10 Visitor Use and Experience / Public Safety

3.10.1 Affected Environment

Visitor use patterns at the Everglades are, in part, influenced by the more than 5.7 million people living within 100 miles, and more than 15.2 million people living within 300 miles of the park (ERA 2007). In addition to visitation from people living in the surrounding area, the park is also receives visitation from vacationers in nearby urbanized areas. For example, more than 8 million people vacation in Miami-Dade County alone (USGS 2004), which would include a trip to Everglades National Park. Everglades National Park visitation is approximately one million visits per year, as shown in Table 3.21. Approximately 50 percent of visitation occurs between January and April.

Table 3.21 – Everglades National Park Visitation

Fiscal Year	Recreational	Non-Recreational	Total Visits*	Percentage Change**
2007	1,068,209	38,883	1,107,092	8.92%
2006	975,234	41,192	1,016,426	-20.02%
2005	1,220,797	50,050	1,270,847	1.31%
2004	1,194,299	60,154	1,254,453	14.89%
2003	1,031,888	59,945	1,091,833	8.41%
2002	940,486	66,693	1,007,179	-11.66%
2001	1,080,250	59,845	1,140,095	11.22%
2000	958,846	66,200	1,025,046	-13.91%
1999	1,125,528	65,190	1,190,718	1.38%
1998	1,113,305	61,219	1,174,524	15.44%
1997	949,714	67,693	1,017,407	11.02%
1996	822,073	94,304	916,377	-4.44%
1995	867,608	91,339	958,947	N/A
* Total visits is the total of recreational and non-recreational visits.				
** Percentage change applies to total visits only.				

Source: http://inside.nps.gov/www.nature.nps.gov/stats

In Spring 2002, a visitor study was conducted at the park that was completed by 623 respondents (Littlejohn 2002). Visitor group size to the park ranged from 1 to 45 people and was made of the following visitor groups: families, friends, those traveling alone, guided tours, school groups, and other.

A summary of these groups, sex, and age of visitors is shown in Table 3.22.

Table 3.22 – Visitor Groups

Size	Types		Sex		Age	
1 – 45 people	Family members	54%	Male	52%	Under 15	11%
	Friends	22%				
	Alone	12%			16-45	40%
	Guided tours	11%	Female	48%		
	School/educational	2%			46-76	49%
	Other	9%				

Source: (Littlejohn 2002)

This survey also gathered information on the ethnic and racial backgrounds of visitors, which was predominantly white (96%). International visitors to the park comprised 14 percent of the total visitation. The countries most often represented were England (36%), Canada (19%) and Germany (17%). The largest proportions of United States visitors were from Florida (34%), New York (7%), and Michigan (6%). Smaller proportions of U.S. visitors came from another 43 states and Washington, DC. As of 2006, the percentage of international visitors had climbed to 25 percent, and visitors from Florida had dropped to 30 percent (ERA 2007). Most of the visitors surveyed (74%) had visited once during the past 12 months, and for the majority (74%), this was the first visit in the past two to five years. The average length of stay for visitors to the park is shown in Table 3.23.

Table 3.23 – Length of Visitor Stay

3 to 4 Hours	7 or more Hours	Less than 24 Hours	2 to 3 Days
43%	21%	72%	19%

Source: (Littlejohn 2002)

An aerial survey of boater use in Everglades National Park was conducted from Fall of 2006 through Fall of 2007 and published in 2008 (Ault et al. 2008). The study examined boater use throughout Florida Bay and Ten Thousand Islands in Everglades National Park, including the Cape Sable area which occurs at the intersection of the Florida Bay and Ten Thousand Island study areas. Table 3.24 shows the results of both the Florida Bay and Ten Thousand Islands areas combined for all vessel types and all seasons during which the study was conducted.

Table 3.24 – Boater Use in Everglades National Park

(Fall 2006 – Fall 2007)

Vessel Type	Number of Vessels	Category (%)				
		Cruising	Diving	Fishing	Other	Party
Flats Boat	6172	24.67%	0.04%	**74.21%**	0.34%	0.79%
Canoe/Kayak	**500**	**76.79%**	**0.00%**	**6.41%**	**7.00%**	**9.79%**
John Boat	368	21.22%	0.55%	**73.94%**	1.10%	3.27%
Rec Small	2679	55.54%	0.48%	**39.51%**	1.29%	3.19%
Rec Chart	292	83.55%	0.00%	**5.50%**	0.35%	10.61%
Sailboat	433	84.76%	0.45%	**2.99%**	0.68%	11.08%
Commercial	186	33.33%	0.00%	**63.45%**	1.09%	2.13%
Other	259	77.63%	0.00%	**2.30%**	13.51%	6.56%

Source: (Ault et al. 2008)

Table 3.24 shows that 500 (5%) of the boats observed during the study were canoes/kayaks. Based on the internal and public scoping processes conducted for this study, canoeists/kayakers are frequent visitors to the Cape Sable area and backcountry wilderness area beyond the Cape Sable canal dams. The study also showed that approximately 6,100 (56%) of the boats observed during the aerial surveys were fishing vessels. Based on the internal and public scoping processes conducted for this study, Cape Sable is a desirable and frequently visited fishing area within Everglades National Park.

The current conditions at each of the existing breached dams in the East Cape Extension and Homestead canals cause safety hazards for visitors engaged in both canoeing/kayaking and fishing activities. Presently, swift currents exist in the East Cape Extension and Homestead canals caused by tidal waters flowing over and around the existing breached dams, making canoeing/kayaking and fishing in these backcountry areas unsafe for visitors. Additionally, the wilderness visitor experience is being hindered for such visitors by the presence of motorized boaters illegally trespassing into the backcountry past the breached dams.

3.10.2 Environmental Consequences

3.10.2.1 Guiding Regulations and Policies

NPS Management Policies 2006

Chapter 8, Section 8.2, Visitor Use, addresses “enjoyment of park resources and values by the people of the United States” as “part of the fundamental purpose of all parks.” The NPS is committed to “providing appropriate, high-quality opportunities for visitors to enjoy the parks,” by

maintaining “an atmosphere that is open, inviting, and accessible” (NPS 2006). Section 8.2.2 of the NPS *Management Policies 2006* discusses recreational activities within the parks, with multiple sections – Management of Recreational Use (8.2.2.1), Backcountry Use (8.2.2.4), Fishing (8.2.2.5) – specifically applicable to use of the Cape Sable area by park visitors.

Section 8.2.5.1 discusses visitor safety in the parks, stating that while “Park visitors must assume a substantial degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments … The saving of human life would take precedence over all other management actions as the [NPS] strives to protect human life and provide for injury-free visits” (NPS 2006). This concern is limited by the constraints of the 1916 Organic Act, which only allows discretionary management activities to be undertaken to the extent that they would not impair park resources and values (NPS 2006). While the NPS acknowledges that there are limitations on its ability to protect park employees and visitors from all hazards, the Service would strive to “provide a safe and healthful environment” (NPS 2006). “When practicable and consistent with congressionally designated purposes and mandates, the Service would reduce or remove known hazards and apply other appropriate measures” (NPS 2006). The NPS would conduct such actions to have the least possible impact on park resources and values (NPS 2006).

Architectural Barriers Act Accessibility Standards (ABAAS)

As outlined in the NPS *Management Policies 2006* and *Director’s Order #42: Accessibility for Visitors with Disabilities in NPS Programs and Services*, as of May 8, 2006, the relevant law for NPS regarding visitors with disabilities is the ABAAS. The Architectural Barriers Act requires that buildings and facilities covered by the law meet standards for accessibility by disabled persons. Such access “would be provided consistent with preserving park resources and providing visitor safety and high quality visitor experiences” (NPS 2006).

3.10.2.2 Assumptions, Methodology and Intensity, Thresholds

General information on visitors to southern Florida and Everglades National Park was collected from NPS visitor statistics and previous studies at Everglades National Park. These data were used to make a qualitative evaluation of the potential impacts to visitor use and experience under each alternative.

The following thresholds were used to assess impacts to visitor use and experience:

Negligible: Visitors would not be affected and/or changes in the experience would be below levels of detection. Visitors would likely be unaware of any effects associated with implementation of the alternative. There would be no noticeable change in visitor use and experience or in any defined indicators of visitor satisfaction or behavior.

Minor: Changes in visitor use and/or experience would be slight but detectable. The changes would not appreciably limit or enhance critical characteristics of the visitor experience. Visitors would be aware of the effects associated with the alternative, but the effects would be slight.

Moderate: Some characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be altered. The visitor would be aware of the effects associated with implementation of the alternative and would likely be able to express an opinion about the changes. Visitor satisfaction would begin to either decline or increase as a direct result of the effect.

Major: Multiple critical characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be greatly reduced or increased. The visitor would be aware of the effects associated with implementation of the alternative and would likely

express a strong opinion about the change. Visitor satisfaction would markedly decline or increase.

Analysis Area: The area of analysis for visitor use and experience is the expanded greater Cape Sable area, since the East Cape Extension and Homestead canals are used as an access point for many surrounding areas in Cape Sable.

3.10.2.3 Impacts of the Alternatives

Alternative A (No-Action)

1) Analysis. The NPS agrees to conduct discretionary management activities in the park in order to protect human life and provide for injury-free visits to the degree that the management activities would not impair the park resources and values (NPS 2006). Taking no action in the interest of visitor safety and experience at the existing breached East Cape Extension and Homestead canal dams would fail to meet the standards of the NPS as outlined in the NPS *Management Policies 2006*. Additionally, if no action is taken, the conditions at the East Cape Extension and Homestead canal dam sites would be expected to worsen, causing a more extreme safety hazard to visitors and further degrading the visitor experience in the wilderness area.

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). Visitor use and experience 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 visitor use and experience 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 visitor use and experience 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, respectively.

3) Conclusion. If no action is taken to rectify the existing unsafe and undesirable conditions at the existing failed East Cape Extension and Homestead canal dam sites, the visitor use and experience at the sites would decline. Conditions at the dam sites would be expected to worsen substantially within the 50-year timeframe of this study, causing a long-term, moderate, and adverse impact on visitor use and experience in the park.

Action Alternative C (Repair in Place)

1) Analysis. Alternative C, repairing the existing East Cape Extension and Homestead canal dams in their current locations, would coincide with the standards of the NPS. Conditions pertaining to visitor safety at the dam sites would improve and visitors would not be subjected to the current rapid flows of water except during high water events during which water levels overtop the dams creating a hydraulic situation with rapid water flow.

A dock structure and safe portage as well as motorized vessel moorings are included in the engineering design for Alternative C, allowing visitors who wish to canoe/kayak or fish in the backcountry wilderness beyond the East Cape Extension and Homestead canal dams to do so safely and without causing harm to the park's resources. As an added safety precaution for boaters, warning signs stating "Warning – No Motorized Access - Submerged Structure" would be posted on both the ends of each of the proposed dam structures. Signs would be anchored

to marine piles and installed in the center access channel of each dam site. Signs would constructed of reflected material and posted a minimum of 5-ft above MHL. These signs would warn visitors of the dam structures at times when high water events cause the dams to be submerged. Additionally, the repairs to the dams would prevent illegal motorized boat entry into the wilderness areas beyond the dam, ensuring that the experience of passive recreational visitors is not hindered in any way. Floating mooring buoys would also be installed downstream (towards Lake Ingraham) of the dam structures for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. As a result, the visitors would be provided with a safe mechanism to secure motorized vessels, while minimizing impacts to the canal bottom, prior to deploying canoes/kayaks to enter the interior wilderness area.

Impacts to visitor use and experience would occur during construction and would consist of access to the East Cape Extension and Homestead canals being blocked temporarily and construction-related noise. Additionally, dredging necessary for construction of Alternative C at the Homestead canal would require for any areas being dredged to be temporarily closed to boating traffic during construction. These impacts would be short-term and temporary and would not extend beyond the timeframe for construction.

By improving both the conditions for safety and passive recreational experience with the repair of the East Cape Extension and Homestead canal dams, it would be expected that existing park visitors would continue to use Cape Sable area. The visitor experience would be very slightly hindered by the presence of the unnatural dam structures. However, the improvements to visitor safety and the natural environment far outweigh any detriment to the visitor experience. Ultimately, park visitors would experience a more natural setting in the Cape Sable area with the implementation of Alternative C.

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). Visitor use and experience 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. This would preserve the visitor experience for a longer time than if no action is taken.

2) Cumulative Impacts. No cumulative impacts to visitor use and experience 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 visitor use and experience 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, respectively.

3) Conclusion. If Alternative C is implemented, the existing unsafe and undesirable conditions at the existing failed East Cape Extension and Homestead canal dam sites would be remedied, including the provision for a safe portage over the dam and prevention of illegal motorized

boaters beyond the dam into the wilderness area. Impacts to visitor use and experience would be long-term and beneficial.

Action Alternatives D (New 100' Plug – Marl Ridge Location) and D1 (New 100' Plug - Geotubes)

1) Analysis. The effects on visitor use and experience would not differ in any way between Alternatives D and D1. However, some elements of implementation and impacts to visitor use and experience would differ moderately from Alternative C. Conditions pertaining to visitor safety at the dam sites would improve and visitors would not be subjected to the current rapid flows of water. Unlike Alternative C, during high water events during which water levels overtop the dams, water flows would be dissipated by vegetation over the length of the plug.

A dock structure and safe portage as well as motorized vessel moorings are still included in the engineering design for Alternatives D and D1, allowing visitors who wish to canoe/kayak or fish in the backcountry wilderness beyond the dams to do so safely and without causing harm to the park's resources. However, the portage would require visitors who wish to cross the dam to carry a canoe or kayak a distance of 100 feet. While this distance is minimal to the visitor in order to provide safe passage over the dam, the extra distance represents slightly more effort than that which would be required with the implementation of Alternative C. Additionally, like Alternative C, as an added safety precaution for boaters, warning signs stating "Warning – No Motorized Access - Submerged Structure" would be posted on both the ends of each of the proposed dam structures.

Alternatives D and D1, as with Alternative C, would also prevent illegal motorized boat entry into the wilderness areas beyond the dam, ensuring that the experience of passive recreational visitors is not hindered in any way. However, a 100-foot plug would more surely guarantee that vandals would not find a way to trench around the dam into the backcountry wilderness, as has occurred with the existing conditions at the site.

Impacts to visitor use and experience would occur during construction and would consist of access to the canals being blocked temporarily and construction-related noise. Additionally, dredging necessary for construction of Alternative D at the Homestead canal would require for any areas being dredged to be temporarily closed to boating traffic during construction. These impacts would be short-term and temporary and would not extend beyond the timeframe for construction.

By improving both the conditions for safety and passive recreational experience with a 100-foot plug dam in each of the canals, it would be expected that existing park visitors would continue to use the Cape Sable area. The visitor experience would be very slightly hindered by the presence of the unnatural dam structures. However, the improvements to visitor safety and the natural environment far outweigh any detriment to the visitor experience.

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). Visitor use and experience 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. This would preserve the visitor experience for a longer time than if no action is taken.

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

3) Conclusion. If Alternative D or D1 is implemented, the existing unsafe and undesirable conditions at the existing failed dam sites would be remedied, including the provision for a safe portage over the dam and prevention of illegal motorized boaters beyond the dam into the wilderness area. Impacts to visitor use and experience would be long-term and beneficial.

Action Alternatives G (New 370'/430' Plug - Marl Ridge Location) and G1 (New 370'/430' Plug - Geotubes)

1) Analysis. The effects on visitor use and experience would not differ in any way between Alternatives G and G1. However, some elements of implementation and impacts to visitor use and experience would differ moderately from Alternatives C and D/D1. Conditions pertaining to visitor safety at the dam sites would improve and visitors would not be subjected to the current rapid flows of water. Unlike Alternative C, during high water events during which water levels overtop the dams, water flows would be dissipated by vegetation over the length of the plug.

A dock structure and safe portage as well as motorized vessel moorings are still included in the engineering design for Alternatives G and G1, allowing visitors who wish to canoe/kayak or fish in the backcountry wilderness beyond the dams to do so safely and without causing harm to the park's resources. However, the portage would require visitors who wish to cross the dams to carry a canoe or kayak a distance of 370 feet for the East Cape Extension canal and 430 feet for the Homestead canal. While this distance is minimal to the visitor in order to provide safe passage over the dam, the extra distance represents slightly more effort than that which would be required to portage a canoe/kayak over a distance of 100 feet with Alternative D/D1 and merely feet with Alternative C.

Like Alternatives C and D/D1, as an added safety precaution for boaters, warning signs stating "Warning – No Motorized Access - Submerged Structure" would be posted on both the ends of each of the proposed dam structures. Signs would be anchored to marine piles and installed in the center access channel of each dam site. Signs would constructed of reflected material and posted a minimum of 5-ft above MHL. These signs would warn visitors of the dam structures at times when high water events cause the dams to be submerged. Floating mooring buoys would also be installed downstream (towards Lake Ingraham) of the dam structures for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. As a result, the visitors would be provided with a safe mechanism to secure motorized vessels, while minimizing impacts to the canal bottom, prior to deploying canoes/kayaks to enter the interior wilderness area.

Alternatives G and G1, as with Alternatives C and D/D1, would also prevent illegal motorized boat entry into the wilderness areas beyond the dam, ensuring that the experience of passive recreational visitors is not hindered in any way. However, a longer plug would more surely

guarantee that vandals would not find a way to trench around the dam into the backcountry wilderness, as has occurred with the existing conditions at the site.

Impacts to visitor use and experience would occur during construction and would consist of access to the canals being blocked temporarily and construction-related noise. Additionally, dredging necessary for construction of Alternative G at the Homestead canal would require for any areas being dredged to be temporarily closed to boating traffic during construction. These impacts would be short-term and temporary and would not extend beyond the timeframe for construction.

By improving both the conditions for safety and passive recreational experience with a plug dam with width of the Marl Ridge in each of the canals, it would be expected that existing park visitors would continue to use the Cape Sable area. The visitor experience would be very slightly hindered by the presence of the unnatural dam structures. However, the improvements to visitor safety and the natural environment far outweigh any detriment to the visitor experience. Ultimately, park visitors would experience a more natural setting in the Cape Sable area with the implementation of Alternative C.

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). Visitor use and experience 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. This would preserve the visitor experience for a longer time than if no action is taken.

2) Cumulative Impacts. No cumulative impacts to visitor use and experience would occur as a result of combining the cumulative projects with the actions contained in Alternative G or Alternative G1 because the effects of the cumulative projects would be negligible. Impacts to visitor use and experience would be limited only to those direct and indirect impacts resulting from implementation of Alternative G 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, respectively.

3) Conclusion. If Alternative G or Alternative G1 is implemented, the existing unsafe and undesirable conditions at the existing failed dam sites would be remedied, including the provision for a safe portage over the dams and prevention of illegal motorized boaters beyond the dams into the wilderness area. Impacts to visitor use and experience would be long-term and beneficial.

3.11 Park Management and Operations

3.11.1 Affected Environment

Park management and operations at Everglades National Park is overseen by the superintendent, who is responsible for managing the staff, concessioners and residents, and

park programs (NPS 2002). Park staff provides the full scope of functions and activities to accomplish management objectives, performing duties that include enforcement, resource protection and management, and interpretation and education. The discussion of park management and operations at both the Homestead canal and East Cape Extension canal areas would be broken down into the following program areas: education, maintenance, and enforcement.

Education and Interpretation

One of the primary functions of Everglades National Park, and all national parks, is to serve educational purposes (NPS 2006). The NPS is committed to extending its leadership in education, building on what is in place, and pursuing new relationships and opportunities to make national parks even more meaningful in the life of the nation (NPS 2006). Within the rich learning environments of Everglades National Park and facilitation by NPS interpreters, visitors would be offered authentic experiences and opportunities to enjoy one of the most beautiful and historic places in America (NPS 2006).

The park's interpretive program is in place to encourage dialogue and accept that visitors have their own individual points of view. Factual information presented is current, accurate, based on current scholarship and science, and delivered to convey park meanings, with the understanding that visitors would draw their own conclusions. The education and interpretive program is also designed to reach out to park neighbors, segments of the population that do not visit the park, and community decision-makers to stimulate discussions about the park and its meanings in local, regional, and national contexts. In addition, interpretive services of the park are designed to help employees better understand the park's history, resources, processes, and visitors. The availability of the Cape Sable area to passive recreational visitors such as those wishing to canoe/kayak in the area is just a small part of the park's natural interpretive features.

Maintenance

Everglades National Park currently has staff in the Maintenance Division. However, responsibility for the park's natural resources and accompanying features such as the East Cape Extension and Homestead canal dams also falls on the park's many scientists, planners, and managers.

There is a maintenance responsibility and cost for every asset that is administered by the NPS. The East Cape Extension and Homestead canal dams are no exception. The costs and the useful life associated with the dams are directly related to the type and level of maintenance provided. Therefore, as outlined in the NPS *Management Policies 2006* for all park facilities, the NPS is committed to conducting a program of preventive and rehabilitative maintenance and preservation, including sustainable design.

The East Cape Extension and Homestead canal dams have a long and extensive maintenance history. The Homestead and East Cape Sable canals are among several canals that were constructed in the Cape Sable area between 1900 and the 1930's, prior to the establishment of Everglades National Park. The purpose of these canals was to drain water from the interior of Cape Sable and make the area useful for agriculture and commerce. Since the completion of the canals, natural forces such as tides and runoff have continually widened the canals and exposed Lake Ingraham to tidal flows resulting in a change in the ecosystem of the Cape Sable region. The Homestead and East Cape Extension canals were plugged with earthen dams in the late 1950's or early 1960's to minimize saltwater intrusion into the formerly freshwater interior mashes behind the marl ridge. However, these dams failed during the late 1980's or early 1990's and were replaced by 20-foot-long sheet-piling dams in 1997 (Technical Information Center 2004). The sheet-pile plugs 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, requiring maintenance (e.g., installation of warning buoys, cables, and signs) over the years to protect the natural resources and visitor safety in Cape Sable.

Enforcement

The law enforcement program is an important tool in carrying out the NPS mission. The objectives of the NPS law enforcement program are (1) the prevention of criminal activities through resource education, public safety efforts, and deterrence; and (2) the detection and investigation of criminal activity and the apprehension and successful prosecution of criminal violators (NPS 2006). In carrying out the law enforcement program, the Service would make reasonable efforts to protect the natural and cultural resources entrusted to its care and to provide for the protection, safety, and security of park visitors, employees, concessioners, and public and private property (NPS 2006). Due to the remote site of the East Cape Extension and Homestead canal dams, enforcement activities are especially difficult and costly.

Illegal activities that have occurred or may occur at the East Cape Extension and Homestead canal dam sites which may require enforcement consist of:

- Illegal motorized boaters trespassing into the Marjory Stoneman Douglas Wilderness Area
- Vandalism to the dam structures
- Motorized boat speeding in no-wake zones or manatee protection zones
- Fishing violations
- Tampering with or disturbance of crocodile nests or eggs

3.11.2 Environmental Consequences

Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. This topic also includes the operating budget necessary to conduct park operations.

3.11.2.1 Guiding Regulations and Policies

Direction for management and operations at Everglades National Park is set forth in the park's enabling legislation, *NPS Management Plan 2006*, *Strategic Plan* (2000), the *Superintendent's Compendium* (NPS 2008), and the General Management Plan (in development).

Education and Interpretation

The Organic Act of 1916 created the NPS to conserve park resources and "provide for the enjoyment of the same in such manner and by such means as would leave them unimpaired for future generations." The purpose of NPS interpretive and educational programs is to advance this mission by providing memorable educational and recreational experiences that would (1) help the public understand the meaning and relevance of park resources, and (2) foster development of a sense of stewardship (NPS 2006).

The NPS *Management Policies 2006* provides guidance and direction in establishing an interpretive and educational program. Section 7 of the NPS *Management Policies 2006* states: "Every park would develop an interpretive and educational program that is grounded in (1) park resources, (2) themes related to the park's legislative history and significance, and (3) park and Service-wide mission goals. The intent would be to provide each visitor with an interpretive

experience that is enjoyable and inspirational within the context of the park's tangible resources and the meanings they represent. In addition, visitors should be made aware of the purposes and scope of the national park system."

Maintenance

The NPS *Management Policies 2006* provides guidance and direction for the park's maintenance programs. Section 9.1.4 of the NPS *Management Policies 2006* states: "the [NPS] would conduct a program of preventive and rehabilitative maintenance and preservation to (1) provide a safe, sanitary, environmentally protective, and aesthetically pleasing environment for park visitors and employees; (2) protect the physical integrity of facilities; and (3) preserve or maintain facilities in their optimum sustainable condition to the greatest extent possible. Preventive and rehabilitative maintenance programs would incorporate sustainable design elements and practices to ensure that water and energy efficiency, pollution prevention, and waste prevention and reduction are standard practice."

Enforcement

The NPS law enforcement program is managed and supervised in accordance with all applicable laws and regulations; Part 446 of the Department of the Interior Manual; all applicable Secretarial directives, the NPS *Management Policies 2006*; and *Director's Order #9: Law Enforcement Program* and Reference Manual #9 (or U.S. Park Police General Orders, as appropriate). The authority and responsibility to manage the NPS Commissioned Park Ranger program and U.S. Park Police operations would flow in a logical order from the Director and in accordance with departmental policy. To help sustain the high level of public trust necessary for an effective law enforcement program, commissioned employees would adhere to the Department of the Interior's law enforcement code of conduct and the standards of ethical conduct found in Reference Manual 9.

3.11.2.2 Assumptions, Methodology, and Intensity Thresholds

Park management and operations, for the purpose of this analysis, refers to the quality and effectiveness of park staff to maintain and administer park resources and provide for an effective visitor experience. This includes an analysis of the projected need for NPS staff time and materials in relation to the visitor services provided under each of the alternatives. The analysis also considers possible staff changes necessary to address the actions proposed under the alternatives and details the adverse or beneficial impacts that may occur.

The following thresholds for evaluating impacts on park operations and management were defined and applied to beneficial and adverse impacts:

Negligible: Park operations would not be affected or an action would have no measurable impact on operations in the park unit.

Minor: Effects to park operations would not be readily apparent and difficult to measure. The impacts on park operations and budget would have little material effect on other ongoing park operations.

Moderate: Effects to park operations would be readily apparent and would measurably affect park operations. The changes would be noticeable to park staff and visitors. Mitigation measures would probably be necessary to compensate for adverse effects and would likely be successful.

Major: Effects to park operations would be readily apparent and would result in a substantial change to park operations. The changes would be noticeable to park staff and visitors and be

markedly different from existing operations. Mitigation measures would be necessary to compensate for adverse effects, and their success would not be guaranteed.

Analysis area: The study area for park management and operations is the primary study area adjacent to the East Cape Extension and Homestead canal dams.

3.11.2.3 Impacts of the Alternatives

Alternative A (No-Action)

1) Analysis. If no action is taken to repair or replace the existing breached dam in the East Cape Extension and Homestead canals, ongoing maintenance and enforcement activities would be required to be carried out by NPS personnel in order to ensure the protection of the park's natural resources and the safety of park visitors. Currently, NPS personnel are required to travel the one hour plus round trip to the East Cape Extension and Homestead canal dams at least monthly to monitor the erosion of the banks and check for any new vandalism to ensure the safety of the park's visitors. The time required for staff to perform these activities reduces the amount of time staff would spend on other park operations such as research and education.

In addition to maintenance and enforcement activities that would need to be performed to ensure the safety of the park's visitors, maintenance would be required to be performed in the long-term to protect the park's resources adjacent to and beyond the East Cape Extension and Homestead dam sites. Some type of barrier would be required to prevent unauthorized motorized boats from trespassing into the Marjory Stoneman Douglas Wilderness area and degrading the resources of the area. The issue of saltwater intrusion into the interior freshwater and brackish marshes of Cape Sable also warrants maintenance of the dam site as the banks of the canal continue to erode (see Chapter 3, Section 4 for details). Erosional processes are also impacting the quality of the East Cape Extension and Homestead canals as a historic structure eligible for listing under the National Historic Preservation Act (see Chapter 3, Section 9 for details). The impacts to these natural resources also in turn impact the interpretive qualities of the Cape Sable area. All of these impacts to the natural and cultural resources (and indirectly educational) of the park would be required to be addressed in the long-term in order to meet the goals of this project and abide by the standards of the NPS as outlined in the NPS *Management Policies 2006*. Consequently, a burden would be put on park resources and staff.

2) Cumulative Impacts. No cumulative impacts to park management and operations 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 park management and operations 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, respectively.

3) Conclusion. If no action is taken at the East Cape Extension and Homestead canal dam sites, park management and operations would be adversely impacted both in the short-term and long-term with the need for maintenance and enforcement activities to ensure the protection of the park's natural resources and the safety of park visitors. The requirements for maintenance and enforcement and the quality of the interpretive features in the Cape Sable area would continue to put a burden on park resources and staff. Impacts to park management and operations would be long-term, minor, and adverse.

Action Alternative C (Repair in Place)

1) Analysis. The implementation of Alternative C, the repair of the East Cape Extension and Homestead canal dams in their current locations, would greatly reduce the current burden on park resources and staff. Based on the 50-year design sustainability of the proposed structures,

maintenance and enforcement activities would be required at the dam sites. Current concerns at the dam sites such as motorized boaters illegally trespassing into the wilderness are beyond the dams, erosion of the banks, vandalism at the dam sites, and degradation of natural resources and interpretive features would be partially reduced with the implementation of Alternative C. Monitoring and maintenance would be required similar to current conditions.

2) Cumulative Impacts. No cumulative impacts to park management and operations 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 park management and operations 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, respectively.

3) Conclusion. If Alternative C is implemented at the East Cape Extension and Homestead canal dam sites, park management and operations would be nearly unchanged from current conditions. The natural resources and interpretive features of the area would be preserved by the implementation of Alternative C. Impacts to park management and operations would be long-term, minor, and adverse.

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

1) Analysis. The implementation of Alternative D or G would greatly reduce the current burden on park resources and staff. Based on the 50-year design sustainability of the proposed structures, only negligible maintenance and enforcement activities would be required at the dam site. Current concerns at the dam sites such as motorized boaters illegally trespassing into the wilderness are beyond the dams, erosion of the banks, vandalism at the dam sites, and degradation of natural resources would be virtually eliminated with the implementation of Alternative D or G. Semi-annual monitoring would be recommended in the first two to five years for exotic control around the construction site and in the long-term for minor preventative maintenance measures (if necessary). Additionally, the portage trail (articulated block mat riprap) along the plug would be required to be maintained free of vegetation for easy passage by visitors carrying a canoe/kayak. A minor amount of additional maintenance would be required for Alternative G than Alternative D due to the increased distance of the portage. Monitoring and maintenance would also be required after any hurricane or severe storm events.

2) Cumulative Impacts. No cumulative impacts to park management and operations 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 park management and operations 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, respectively

3) Conclusion. If Alternative D or G is implemented at the East Cape Extension and Homestead canal dam sites, park management and operations would be beneficially impacted with the need for maintenance and enforcement activities reduced. The natural resources and interpretive features of the area would also be preserved by the implementation of Alternative D or G. Impacts to park management and operations would be long-term and beneficial.

Action Alternatives D1 (New 100' Plug - Geotubes) and G1 (New 370'/430' Plug - Geotubes)

1) Analysis. Similar to the other action alternatives, the implementation of Alternative D1 or Alternative G1 would greatly reduce the current burden on park resources and staff. Based on the 50-year design sustainability of the proposed structure, only negligible maintenance and

enforcement activities would be required at the dam site. Current concerns at the dam sites such as motorized boaters illegally trespassing into the wilderness are beyond the dam, erosion of the banks, vandalism at the dam site, and degradation of natural resources and interpretive features would be virtually eliminated with the implementation of Alternative D1 or Alternative G1. Semi-annual monitoring would be recommended in the first two to five years for exotic control around the construction site and in the long-term for minor preventative maintenance measures (if necessary). Additionally, the portage trail (articulated block mat riprap) along the plug would be required to be maintained free of vegetation for easy passage by visitors carrying a canoe/kayak. A minor amount of additional maintenance would be required for Alternative G1 than Alternative D1 due to the increased distance of the portage. Also, differing from Alternatives D and G, the geotubes, while armored with rip-rap, would be somewhat more susceptible to damage than the sheetpile, requiring more consistent monitoring and potentially additional maintenance. Monitoring and maintenance would also be required after any hurricane or severe storm events.

2) Cumulative Impacts. No cumulative impacts to park management and operations 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 park management and operations would be limited only to those direct and indirect impacts resulting from implementation of Alternative 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, respectively.

3) Conclusion. If Alternative D1 or G1 is implemented at the Homestead canal dam site, park management and operations would be beneficially impacted with the need for maintenance and enforcement activities reduced. The natural resources and interpretive features of the area would also be preserved by the implementation of Alternative D1 or G1. Impacts to park management and operations would be long-term and beneficial.