CHAPTER 3

AFFECTED ENVIRONMENT

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3.0 AFFECTED ENVIRONMENT

This chapter provides a description of the physical, biological, chemical, and human environments that could be affected by alternatives evaluated. The existing conditions are presented in either a regional- or area-specific context depending on the nature of the resource or the anticipated effect to that resource.

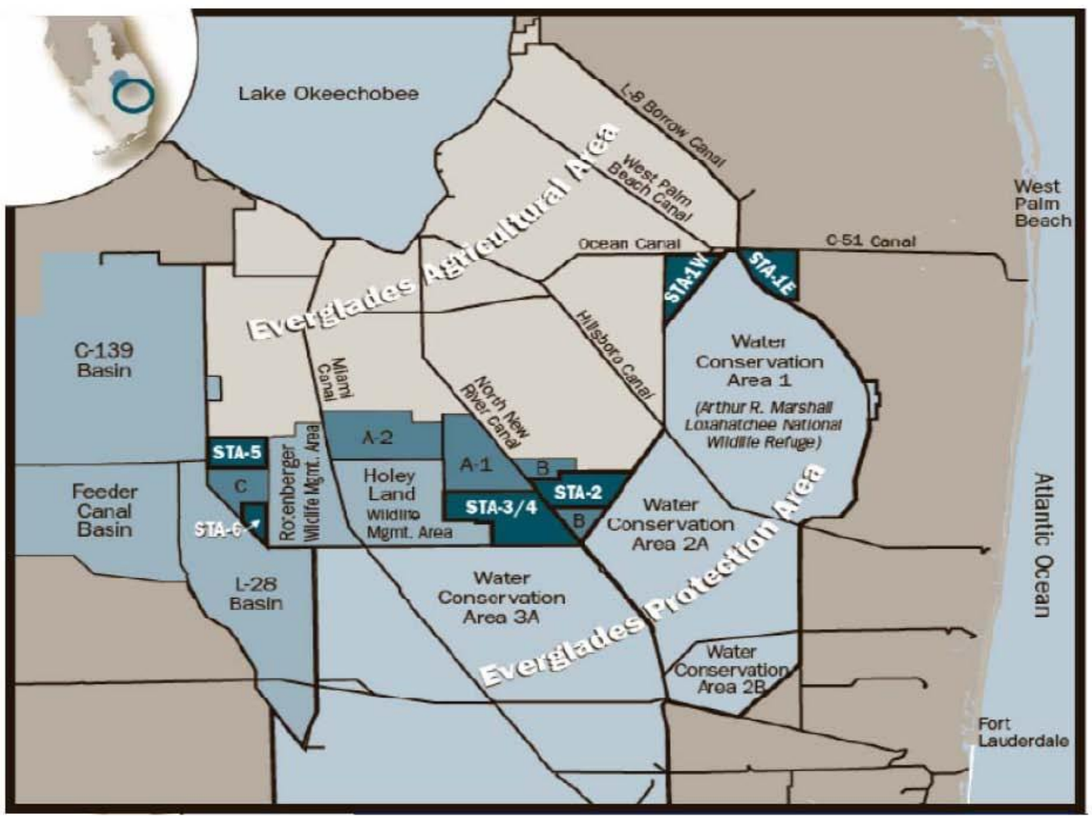
3.1 GENERAL ENVIRONMENTAL SETTING

Lake Okeechobee, located north of the project area, is an approximately 730-square-mile freshwater lake located north of the Everglades Agricultural Area (EAA) with an average depth of roughly 9 feet (USACE 2007a). The depressional area, now occupied by Lake Okeechobee, was formed approximately 6,000 years ago when the Okeechobean Sea receded (Lodge 2004). The depressional area then filled with water during the following period of wetter conditions. Historically, water flowed south from the lake to the Everglades through a series of small tributaries at the southern portion of the lake. Once the headwaters of the Everglades, the waters are now contained by the Herbert Hoover Dike and by an earthen levee around the southern perimeter of the lake. Discharges, water levels, and flows are highly managed through a series of water control structures and canals including the structures that discharge water to the EAA.

The EAA is located south of Lake Okeechobee primarily in western Palm Beach County (**Figure 3-1**), extending south to Water Conservation Area (WCA) 3A. It is bounded on the east by the Arthur R. Marshall Loxahatchee National Wildlife Refuge, which is WCA-1 (herein referred to as the Refuge), WCA 2A, the Western C-51 Basin, the L-8 Basin, and on the west by the C-139 Basin. Historically, the EAA was pond apple swamp forest on the southern shore of Lake Okeechobee and an extensive sawgrass wetland, which have been drained and put into agriculture production. The former wetlands produced the rich organic peat and muck soils that today make it a highly productive agricultural area. As of September 30, 2011, there were 474,622 acres of land under active agricultural production in thirty-two (32) South Florida Water Management District (SFWMD) permits in the EAA (Office of Agricultural Water Policy 2011). The agricultural area designation was formally established in the 1950s and associated water management infrastructure was substantially completed in 1962 (USACE and SFWMD 2004). As of 2004, sugar cane was reported to be the area’s dominant crop with approximately 898 square miles (575,000 acres) of active sugar cane fields; this harvest provides 50 percent of the sugar produced nationally (USACE and SFWMD 2004).

Runoff from the EAA, which contains relatively high levels of nutrients (mainly phosphorus and nitrogen from particulate matter and fertilizers), drains from the agricultural canals to the secondary canals, then into the six main primary canals, and are eventually discharged into the Everglades Protection Area (EPA) or to tide. In addition to flood protection, the canals and water control structures convey regulatory and/or water supply releases from Lake Okeechobee to the EAA, the WCAs, and the Everglades National Park (ENP). The canals also provide for municipal water supply to eastern Palm Beach, Broward, and Miami-Dade Counties (Cooper 1989).

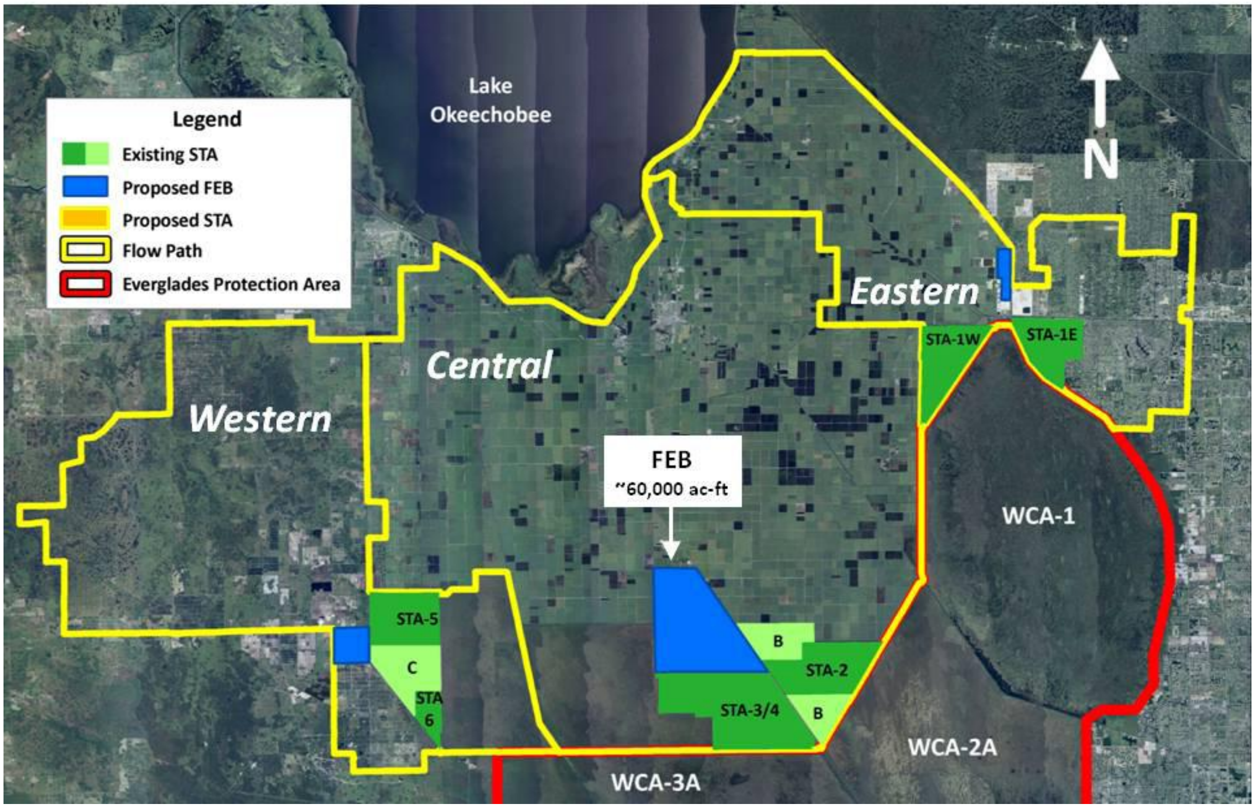
Figure 3-1 Major Areas of the South Florida Environment. Image: Pietro et al., 2008.



As described in Chapter 1, the Central Flow Path consists of the bulk of the EAA. In relation to the above described features, Compartment A-1 (A-1 project site) is at the south central portion of the Central Flowpath and immediately north of Stormwater Treatment Area (STA) 3/4 (**Figure 3-2**). The project site is approximately 16,000 acres and bordered to the east by United

States (US) Highway 27, to the south by STA 3/4, to the west by an area known as the Holey Land Wildlife Management Area (Holey Land) and to the north by agricultural lands.

Figure 3-2 Map of Western, Central and Eastern Flow-paths



3.2 SCOPE OF THE AFFECTED ENVIRONMENT

The following regions comprise the extent of the affected regions for all alternatives:

- the Central Flow Path
- project site
- STA 2
- STA 3/4
- WCA 2A
- WCA 3A; and
- Holey Land Wildlife Management Area

The physical, biological, chemical, and human environments of those areas that may be affected include land use; geology, topography, and soils; hydrology to include surface water and ground water hydrology; water quality; climate; vegetation and cover types; threatened and endangered species; fish and wildlife species; aesthetics; cultural, historic and archaeological resources; socioeconomics; environmental justice; recreation; hazardous and toxic wastes; and flood protection. The spatial extent of the effect for each components described in this chapter varies based on the geographic extent of effects on the environment being described and will be addressed by topic.

Areas not considered as part of the affected environment include Lake Okeechobee, C-139 Basin, and the Rotenberger Wildlife Management Area since the No Action Alternatives and the Action Alternatives would have no effect on these areas.

3.3 LAND USE

The general pattern of land use within the region of South Florida consists of an expanding zone of urban development within the coastal strip adjacent to the Atlantic Ocean; a large area dominated by intensive agricultural use east, south, and west of Lake Okeechobee; and a band of largely undeveloped land within the EPA. The following discussion addresses existing land use patterns within the project site, the STAs and other areas including the WCAs and the Holey Land.

3.3.1 PROJECT SITE

On March 26, 1999, the Nature Conservancy (TNC) closed on the acquisition of approximately 50,000 acres of land located within the southern portion of the EAA in Palm Beach and Hendry Counties. This acquisition was the culmination of many years of negotiations. The complex transaction was structured in two phases involving agreements between Talisman Sugar Company and other sugar companies, the Departmetn of the Interior (DOI), TNC, and the SFWMD. The DOI provided $99,434,312 in federal Farm Bill funds for the acquisition of these lands and the SFWMD provided $12,939,906. Compartments A, B, and C lands were purchased in part with this acquisition as described in the Framework Agreement

The land acquisition included the 16,000-acre A-1 project site. The SFWMD has managed the A-1 property under agricultural leases prior to the land being utilized for a restoration project. A project to construct a reservoir on the A-1 project site was included in the Comprehensive Environmental Restoration Plan (CERP) as it was designed to improve the quantity, quality, timing and delivery of water in the Everglades. The reservoir would have provided water storage in order to improve timing of water deliveries from the EAA to the WCAs, reduce Lake Okeechobee regulatory releases to the estuaries, meet supplemental agricultural irrigation demands, and increase flood protection within the EAA. In 2006, SFWMD was given Department of the Army (DA) authorization to construct the reservoir on the A-1 project site. USFWS/DOI provided approval for the interim land use change for construction of the reservoir.

3.3.2 STORMWATER TREATMENT AREAS

STA 2 (including Compartment B) and STA 3/4 were constructed and are being operated to provide water quality improvement in discharges to the EPA. Physical features within the existing STAs include the constructed wetlands and the associated water management infrastructure (such as levees, canals, and water control structures). Land cover within the STAs is primarily a mixture of open water, emergent, and submergent marshes. Land use for these areas can be classified as public/institutional or conservation. To varying degrees, the STAs also support ancillary recreational uses such as hunting, fishing, and wildlife viewing.

3.3.3 WATER CONSERVATION AREAS AND HOLEY LAND WILDLIFE MANAGEMENT AREA

WCAs 2 and 3 abut the southern boundaries of the EAA (**Figure 3-1**). WCAs 2A and 3A were designated primarily to receive flood waters from adjacent areas and store the waters for beneficial municipal, urban, and agricultural uses; however, they are currently managed for multiple uses including flood protection, water supply storage, and environmental resource protection. The Holey Land is managed for environmental resource protection. The Florida Fish and Wildlife Conservation Commission (FWCC) currently manages the fish and wildlife resources in the WCAs and the Holey Land.

3.4 GEOLOGY, TOPOGRAPHY, AND SOILS

3.4.1 GEOLOGY

At the project site, the upper carbonate sand and limestone constitutes the Fort Thompson Formation. Below this, shelly sand and sparse limestone constitutes the Caloosahatchee Formation and possibly part of the Tamiami Formation. The top of the Fort Thompson Formation consists of a hard limestone layer about four and a half to five feet thick, which is locally called caprock. The caprock is generally white, light gray, tan or yellowish brown. The caprock is underlain by silty carbonate sand extending to about 23.5 to 24.5 feet deep, where another hard limestone layer one and a half feet to three feet thick is encountered. A thinner, hard limestone layer about one half foot to one foot thick is often encountered at around 16 to

17 feet deep. The sand and lower limestone layers are generally white to very pale brown. Laboratory testing of the sand sampled in the borings averaged 84.2 percent calcium carbonate content with an average of 22 percent passing the #200 sieve in gradation tests. Visual inspection of the sand samples from the borings revealed that they include shell fragments, and tend to be angular and platy (USACE 2006).

All the Fort Thompson Formation limestone layers exposed in core or in excavations at the project site are very fossiliferous. The sand exposed in the seepage collection canals and dewatering sumps was abundantly fossiliferous with gastropods, pelecypods, corals, and echinoderms.

Portions of the project site and surrounding areas also contain the Caloosahatchee Formation. The top of the Caloosahatchee Formation is composed of fine grained, subrounded, shelly quartz sand that is mixed with shelly carbonate sand similar to that in the Fort Thompson Formation. The Caloosahatchee Formation at the site is 30 to 60 feet thick; however, the interface between this formation and the underlying Tamiami Formation is difficult to define. The proportions of carbonate to quartz sand vary. Laboratory testing on the sampled sand indicated an average calcium carbonate content of 40.1 percent and an average of 12.1 percent of material passing through the #200 sieve. The primary color of the geologic material in the Caloosahatchee Formation is light greenish gray (USACE 2006).

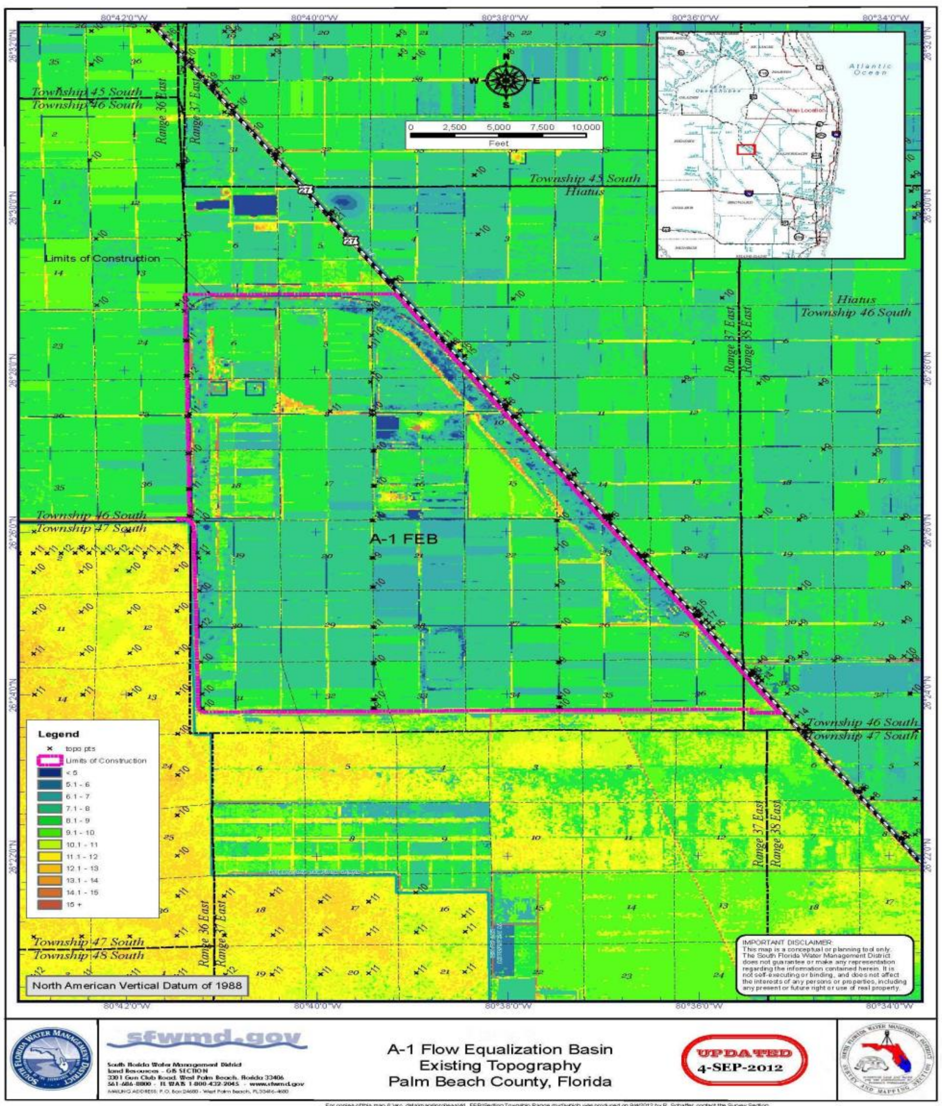
Other geologic information may indicate that the Caloosahatchee Formation is not present at the project site. For instance, geological work (Reese and Cunningham, 2000) has redefined the stratigraphy of the area. Presently, the Tamiami Formation has several recognized named and unnamed geologic members including the Ochopee Limestone Member and the Pinecrest Sand Member. Both Tamiami Formation members contain sandy strata, but the Pinecrest Sand Member is principally shelly, fine grained, quartz sand. Therefore, interpretation of the contact between the Caloosahatchee Formation and Tamiami Formation at the project site is not possible (USACE 2006).

3.4.2 TOPOGRAPHY

The Central Flowpath consists of agricultural lands in the EAA, the project site, STAs 2 and 3/4, and the Holey Land, while WCA 2A and WCA 3A are located south of the Central Flowpath. The topography within the Central Flowpath and the WCAs 2A and 3A is relatively flat. The EAA contains elevations generally less than 18.6 feet North American Vertical Datum (NAVD) 1988, and the ground surface generally slopes from north to south with an average gradient of 0.15 foot per mile.

With the exception of work performed at the site under the permit for the previous A-1 Reservoir Project, the majority of elevations of the unfilled and unexcavated areas at the site range from 7 to 9 feet NAVD 1988 (SFWMD recordings, 2012). A seepage canal was constructed just within the east, west, and north property borders of the project site, with elevated areas inside the canal where the associated fill was placed. In addition, a remnant mining area in the northeast portion of the project site has elevations less than 5 feet NAVD 1988, and an adjacent stockpile area with elevations up to 15 feet NAVD 1988. The elevations of areas surrounding the project site generally range from 6 to 11 feet NAVD 1988 (SFWMD recordings, 2012). See **Figure 3-3** for site elevations.

Figure 3-3 A-1 Project Site Existing Topography



3.4.3 SOILS

According to the United States Department of Agriculture Soil Survey of 1988, 96 percent of the EAA is composed of the following series of soils: Torry muck (7%), Terra Ceia muck (9%), Pahokee muck (27%), Lauderhill muck (40%), Dania muck (10%), and Okeechobee muck (3%). The remaining 4 percent of the EAA is composed of sands (Okeelanta muck) (Bottcher and Izuno 1994). Historically, the EAA was part of the largest region of organic soils, commonly 14 feet thick or more. Through the years of draining and agricultural production, these soils have been significantly reduced or in some areas even lost completely (Lodge 2004). Recent studies have been conducted on the subsidence of soils in the EAA, and it is projected that by 2050 nearly half of the EAA will have less than 8 inches of soil, which means the soil elevation on average is decreasing 0.6 inches a year (Snyder 2004).

The A-1 project site contains Pahokee muck (primarily in the southern portion of the site) and Lauderhill muck (primarily in the northern portion of the site). Numerous soil borings, taken from 50 to 100 feet below ground surface, were completed within the project site in December 2004 and January 2005. The borings generally penetrated through approximately one half to two feet of surficial peat/muck and marl, then through 22 to 26 feet of primarily carbonate sand and limestone, and then into primarily shelly quartz sand with sparse limestone to their completed depths. The marl beneath the peat and muck is known by some authors as the Lake Flirt Marl (Reese and Cunningham, 2000; Harvey et. al., 2002), but is undifferentiated from the peat and muck layer for this EIS.

South of the EAA, the WCAs and Holey Land primarily consists of muck and peat type soils, with the underlying substrate classified as marl and/or limestone. Other soils in these areas that have poor natural drainage (predominantly alfisols and entisols with histosols) include fine sand and loamy material.

Figures 3-4 and 3-5 Photos of Peat and Marl Soils of the Everglades, respectively (from Scheidt and Kalla, 2007)

3.5 HYDROLOGY

Water in the EAA is managed to provide flood protection, irrigation, and fresh water for the EAA and surrounding environmentally sensitive areas through a series of canals, levees, culverts, gates, and pumps (USACE and SFWMD 2004). Within the Central Flowpath, three major canals pass through the EAA and receive flows from Lake Okeechobee and runoff from the EAA: Hillsboro Canal, North New River Canal, and Miami Canal. Discharge from Lake Okeechobee and runoff from the EAA, which contain relatively high levels of nutrients (mainly phosphorus and nitrogen from particulate matter and fertilizers), drain from the agricultural canals, to the secondary canals, into the primary canals. These three canals discharge to the STAs through pump structures as detailed below.

STAs outflow into WCAs, which serve as surface water impoundments developed to provide water supply, water storage, flood control, and wildlife conservation (SFWMD 2007) and are subjects of Everglades restoration activities. At times, when conditions do not allow for the STAs to treat all runoff water prior to discharge, diversion to the WCAs may occur without treatment. WCAs are Everglades wetlands surrounded by levees and typically include a rim canal located on the inside of the levees next to the largely undisturbed peat soils and wetland plant communities. The marsh vegetation, along with the east coast protection levee, prevents floodwaters that historically flowed eastward from the Everglades from flowing into the developed areas along the southeast coast of Florida (USACE 2011).

3.5.1 OVERALL WATER MANAGEMENT

Currently, water levels in Lake Okeechobee are managed by a regulation schedule by transferring water through a complex system of pumps and locks. The Lake Okeechobee regulation schedule attempts to achieve the multiple-use purposes as well as provide seasonal lake level fluctuations. Flood control improvements around Lake Okeechobee consist of a system of approximately 1,000 miles (1,600 km) of encircling levees, designed to withstand a severe combination of flood stage and hurricane occurrence.

The management of water from Lake Okeechobee to the EPA is through the network of canals constructed as a result of the Central and Southern Florida (C&SF) Project. The C&SF Project's intention was to provide water storage in the WCAs and to better control water levels in the Everglades for multiple purposes. The construction of canals, levees, and roads has eliminated the historical freshwater sheet flow and resulted in changes in the timing and quantity of flow within the system that have influenced water quality conditions and impacted the downstream EPA. On average, about 900,000 ac-ft of water is discharged from and through the EAA to the south and southeast, historically mostly discharging into the EPA (Abtew and Khanal, 1994; Abtew and Obeysekera, 1996). Four primary canals (Hillsboro Canal, North New River Canal, Miami Canal, and West Palm Beach Canal) and three connecting canals (Bolles Canal, Cross Canal, and Ocean Canal) facilitate runoff removal and irrigation water supply. Currently runoff/drainage from the EAA is discharged to the STAs for treatment and released to the WCAs.

The WCAs are regulated for the Congressionally-authorized C&SF project purposes to provide flood control; water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation (USACE 2011). The current operating regime for WCA 3A is Everglades Restoration Transition Plan (ERTP). ERTP superseded the 2006 Interim Operational Plan (IOP) because the IOP was no longer a viable option for water management within WCA 3A based on the status of endangered species within WCA 3A. The ERTP maximizes operational flexibilities to provide further hydrological improvements consistent with protection of multiple listed animal species, including the Everglades snail kite, wood stork and other wading birds and their habitats in south Florida, while maintaining nesting season requirements for the Cape Sable Seaside Sparrow, along with C&SF Project purposes. Water management operating criteria outlined within ERTP is to be superseded once the features of the Modified Water Deliveries (MWD) to the Everglades National Park project and the C-111 Project are available for water management operations. Therefore, the ERTP serves as a transition plan between the previous 2006 IOP for Protection of the Cape Sable Seaside Sparrow and a future operational plan.

Currently, the MWD Project elements are scheduled to be constructed by the end of 2013. (USACE March 2011).

3.5.2 SURFACE WATER

3.5.2.1 Project Site

The surface water hydrology at the A-1 project site is currently rainfall driven. The site was previously farmed as agricultural lands, but the agricultural activities have ceased. As a result of the prior construction activities for the A-1 Reservoir, a seepage canal was constructed within the north, east and west border of the project site. The canal was not completed. To maintain flow, the levee at the south end of the A-1 project site was degraded to allow surface runoff to enter the STA 3/4 seepage canal. Therefore, the surface waters currently flow from the existing agricultural ditches to the STA 3/4 seepage canal.

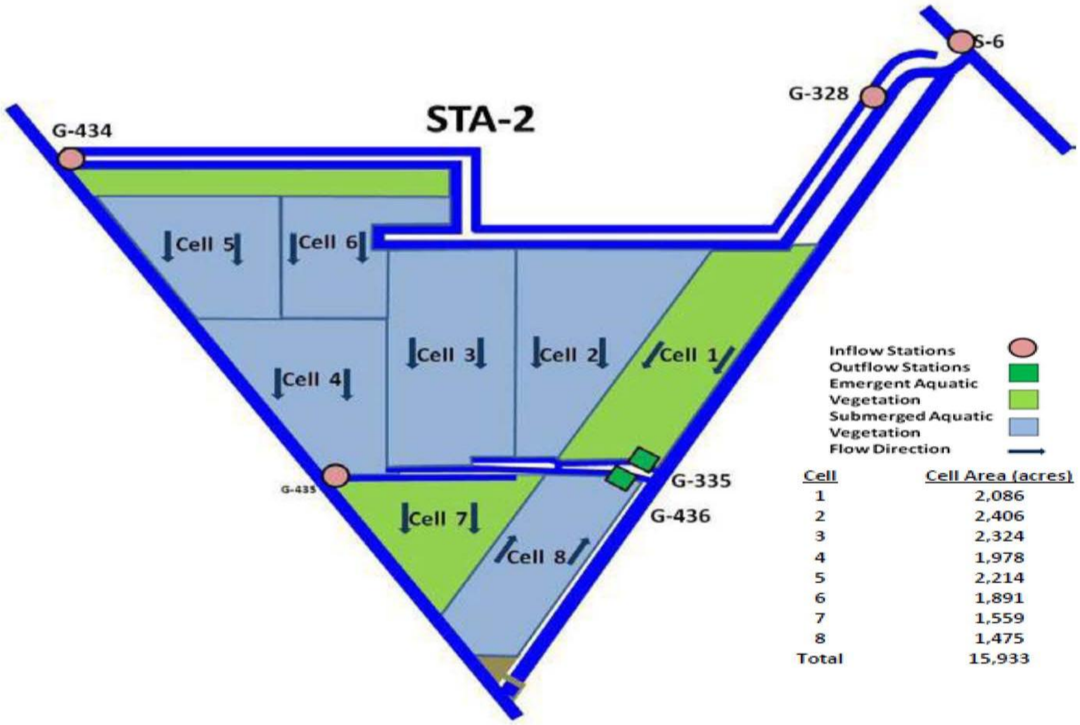
3.5.2.2 Stormwater Treatment Area 2

The general management goal for STAs is to maintain shallow inundation in emergent aquatic vegetation cells (EAV) for most of the year and to maintain shallow inundation of submerged aquatic vegetation (SAV) cells throughout the year. Dry out and desiccation of submerged aquatic vegetation and associated periphyton communities causes mortality and a significant reduction in phosphorus removal performance.

Inflows. STA 2 currently receives water from the North New River Canal, which is pumped into the STA via the G-434 and G-435 pump stations. Runoff collected via the Hillsboro Canal is pumped into STA 2 via the S-6 pump station. In addition, runoff from agricultural lands adjacent to STA 2 is pumped into STA 2 via the G-328 pump station.

Outflows. Treated discharges from STA 2 are pumped into the L-6 Canal via the G-335 and G-436 pump stations, and then conveyed to either northern WCA 2A through a set of box culverts or to western WCA 2A through a section of degraded L-6 Canal levee. See **Figure 3-6** for a simple schematic of STA 2.

Figure 3-6 Simplified schematic of STA 2 showing major inflow and outflow structures, flow directions, and dominant/target vegetation types

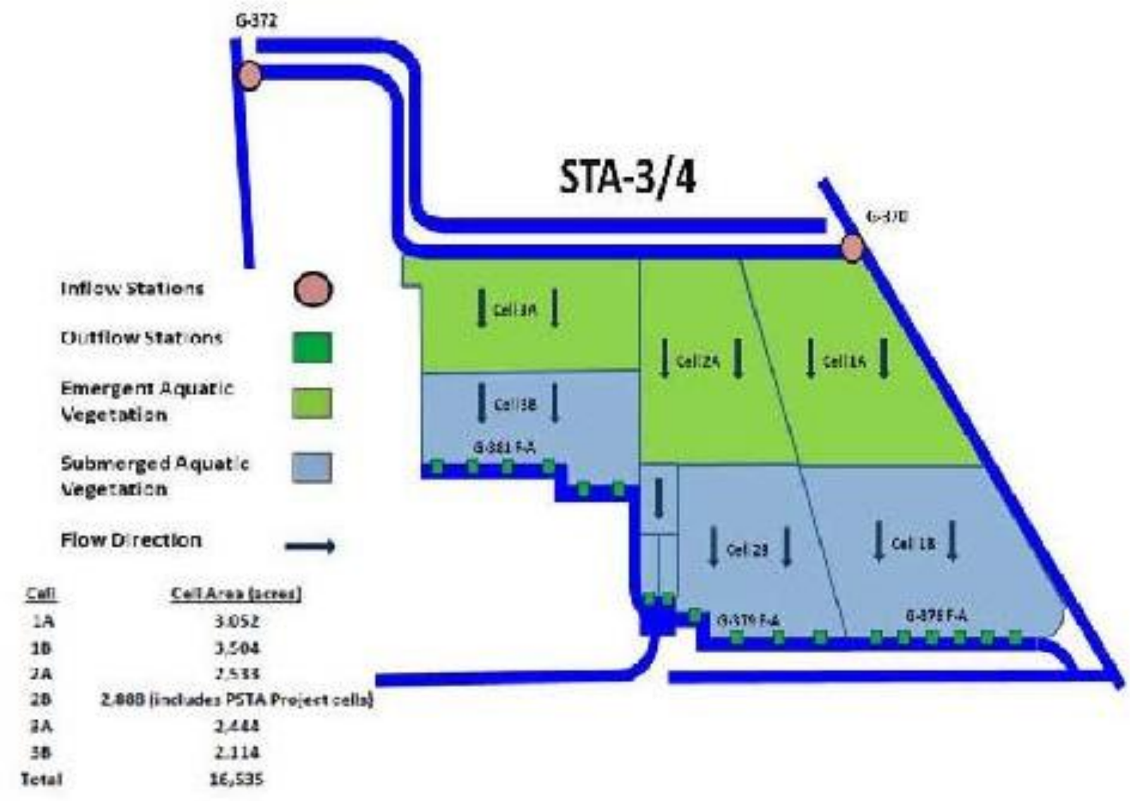


3.5.2.3 Stormwater Treatment Area 3/4

Inflows. STA 3/4 currently receives agricultural and/or urban runoff from the S-2, S-3, S-7, S-8, and C-139 Basins, the South Shore Drainage District and the South Florida Conservancy District. Runoff collected by the North New River Canal is pumped into STA 3/4 via the G-370 pump station. Runoff collected via the Miami Canal is pumped into STA 3/4 via the G-372 pump station.

Outflows. Treated discharges from STA 3/4 are conveyed to the STA 3/4 Discharge Canal and L-5 Canal, and then conveyed to either western WCA 2A via the S-7 pump station, to eastern WCA 3A via S-150, or western WCA 3A via the S-8 pump station. Pump station G-404 can also be operated to convey treated STA 3/4 discharges to the northwest corner of WCA 3A and to provide supplemental irrigation water supply to the Big Cypress Seminole Indian Reservation (in conjunction with pump station G-409). See **Figure 3-7** for a simple schematic of STA 3/4.

Figure 3-7 Simplified schematic of STA 3/4 showing major inflow and outflow structures, flow directions, and dominant/target vegetation types



3.5.2.4 Water Conservation Area 2A

Water within either the Hillsboro Canal or the North New River Canal enters into WCA 2A from STA 2 and STA 3/4 primarily through pump stations S-7 (STA 3/4), G-335 (STA 2), and G-436 (STA 2). Pump stations deliver water from the canals to the WCAs. The S-7 pump station has an adjacent gated spillway that can be opened to allow water supply deliveries from WCA 2A to the EAA. Surface water inflows to WCA 2A also enter from the Refuge through the S-10A, S-10C, and S-10D spillways located along the L-39 Levee. An interior levee (L-35B) across the southern portion of WCA 2 subdivides WCA 2A from WCA 2B. The majority of the surface water flows from WCA 2A into WCA 3A primarily through the S-11 spillways; however, a portion is released via the S-144, S-145 and S-146 structures to WCA-2B. When pool elevations in WCA 2B exceeds 11.0 feet NGVD, water is discharged from WCA 2B to the North New River Canal via spillway structure S-141.

3.5.2.5 Water Conservation Area 3A

WCA 3A receives water from Lake Okeechobee, WCA 2 and the EAA via the North New River and Miami Canals with the majority of the inflows delivered from WCA 2A through the S-11 spillways. Another large source of water entering into WCA 3A is from STA 3/4 and STA 5, which enter through the S-8 and G-404 pump stations, and the S-150 and G-357 culverts, all of which are located at the northern boundary of WCA 3A. Under high water conditions, water flows across the open portion of the western boundary of WCA 3A and into Big Cypress National Preserve. However, surface outflows are primarily made to the ENP through the S-12 spillways and the S-333 structure.

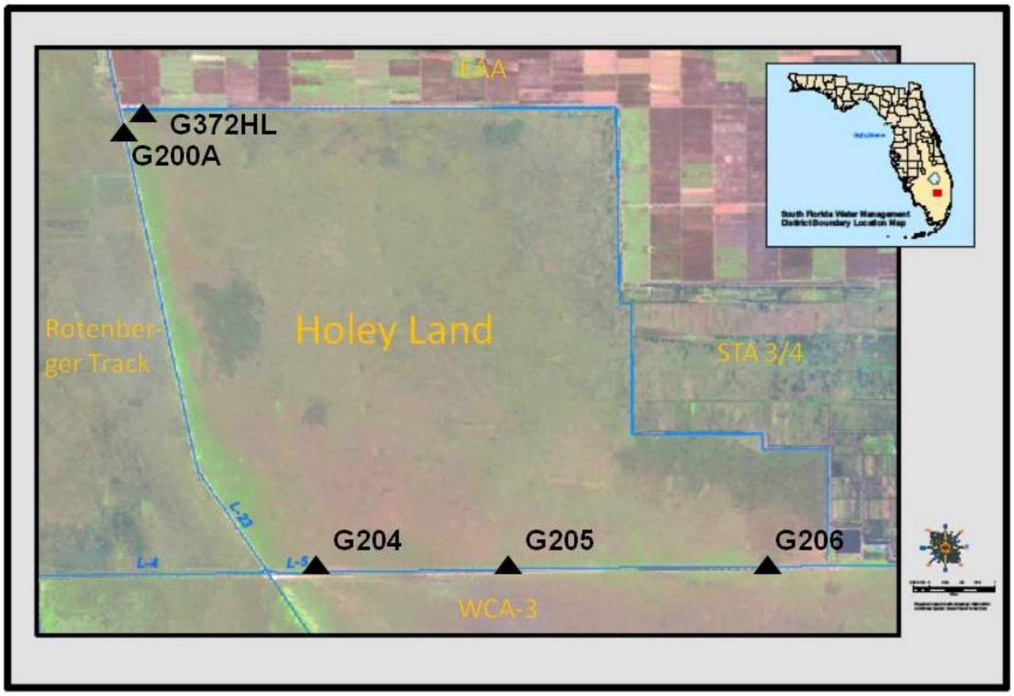
The S-140 pump station discharges runoff from the C-139 Annex, as well as the Seminole Tribe of Florida Big Cypress Reservation and the Miccosukee Tribe of Indians of Florida Reservation located along the northwestern boundary of WCA 3A. Water supply deliveries to the Seminole Tribe of Florida Big Cypress Reservation are made via the G-409 pump station located just west of the northwest corner of WCA 3A. Sources of water for this pump station include Lake Okeechobee (delivered via the G-404 pump station), STA 3/4, STA 5, STA 6, Rotenberger and Holey Land WMAs, EAA runoff, and WCA 3A.

Interior levees (L-67AC) across the southeast portion of WCA 3 subdivide WCA 3A from WCA 3B. WCA 3B receives most of its water from rainfall, but occasionally receives water supply releases from WCA 3A via the Miami and L-67 Canals (through S-151). Water is discharged from WCA 3B to the adjacent basins through the S-31 and S-337 structures via the Miami Canal, although plans are underway to enable discharges to the Northeast Shark River Slough along the northeast boundary of ENP from WCA 3B via the S-355 structures (Cooper, 1991; Grein et al., 2003; Hwa, 2003; SFWMD, 2000; SFWMD Operations, 2003; Smelt, 2003; STRIVE, 1999; and USACOE, 1999).

3.5.2.6 Holey Land Wildlife Management Area

Historically, inflows to Holey Land occurred via inflow pump station G-200A. The source of inflows was the portion of the Miami Canal (L-23, L-24 and L-25) south of STA 3/4 diversion structure G-373, which typically contains stormwater runoff that has been treated by either STA 3/4 or STA 5/6. However, in October 2005, Hurricane Wilma severely damaged G-200A, rendering it inoperable. To date, this pump station has not been replaced. As a result, limited surface water inflow capacity exists through the G-372HL box culvert located near STA 3/4 inflow pump station G-372. Outflows from Holey Land to the L-5 Canal could occur via culverts with flashboard risers (G-204, G205 and G-206) (SFWMD, 2013). However, since April 2008, there has been no surface water inflow to the Holey Land, and no outflows have occurred since January 2006. Essentially, Holey Land has become a rainfall-driven system and no longer functions as a flow-through system (**Figure 3-8**). The area dries out routinely, and re-wets depending on rainfall amounts (SFWMD, 2013).

Figure 3-8 Location of Holey Land Wildlife Management Area



3.5.3 GROUNDWATER

The Lake Okeechobee area contains a surficial aquifer system consisting of all the rocks and sediments from land surface to the top of the limestone. In the Central Flow Path, the high organic content of the soil makes the surficial groundwater generally undesirable for domestic use except close to Lake Okeechobee. This aquifer is recharged directly by two sources: Lake Okeechobee and rainfall. Lake Okeechobee provides water for a variety of consumptive demands, including urban drinking water, irrigation for agricultural lands, and recharge for wellfields.

Beneath the surficial aquifer is the Floridan aquifer system. It is the largest aquifer in Florida and the most productive in the world. This system underlies an area of approximately 100,000 square miles (258,999 km2) in Florida, southeastern Alabama, southern Georgia, and southern South Carolina. This aquifer is composed of a thick sequence of limestone layers and is divided into Upper Floridan and Lower Floridan, by a less permeable middle confining unit of carbonates. In the EAA, the water of the Floridan aquifer is rather salty, particularly in the Lower Floridan (Sprinkle, 1989).

The intermediate confining unit is located approximately 200 to 250 feet below ground surface (bgs) and will restrict any seepage from the project site that might reach this depth. There is a high degree of communication between groundwater and surface water in the area, the groundwater gradient in the surficial aquifer system is controlled, to a large extent, by the operation of the hundreds of canals throughout the region. Therefore, even though the general regional gradient in the surficial aquifer system is believed to be southward, localized gradients may actually be in other directions in portions of the area surrounding the project site due to the operation of canals and wells in the region.

3.5.4 STA PHOSPHORUS REMOVAL

Native soils within STA 2 (including Compartment B) and STA 3/4 are primarily organic muck. As dead emergent plant material is accumulated in the EAV cells, the material slowly is converted to a layer of peat soil. In submerged aquatic vegetation cells, the decomposing plant matrerials form mostly mineral soils. The accretion of new soil primarily from vegetation and detritus material in the STA occurs at a rate of approximately 1.2 ± 0.3 and 1.7 ± 0.8 cm/yr, respectively (Bhomia, Rupesh 2012).

STAs remove phosphorus from water by channeling the water through shallow marshes with either emergent wetland vegetation or submerged wetland vegetation, both of which remove phosphorus in different ways (**Figure 3-9**). For SAV-based treatment, the dominant phosphorus removal pathway binds inorganic phosphorus with soil calcium while EAV treatment enhances phosphorus storage by plant uptake and peat burial (Bhomia and Reddy 2012). Water containing inorganic phosphorus enters the wetland system. In the EAV treatment system, the wetland plants take up or absorb phosphorus from the water. As the plant material decomposes, the detritus material containing the phosphorus become sediments and provides substrata for microbial growth where phosphorus is converted to a bioavailable form. In the SAV treatment system, the limestone layer beneath the sediment absorbs or co-precipitates the phosphorus and makes it unavailable. As a whole system, phosphorus reduction in the STAs is carried out by the various physical, chemical, and biological processes, but it primarily takes place at the soil-water-plant roots interface, assisted by microbes in the water column and within the soil layer. Ultimately, the removal of phosphorus occurs as it is sequestered in the accreted soils.

STAs periodically experience dryout events as a result of drought conditions or management related activities (**Figure 3-10**). Upon re-flooding, phosphorus stored in the soils can be re-mobilized into the water column and released into downstream canals and/or wetlands (**Figure 3-11**). Several factors can potentially affect phosphorus release from STA soils. These include, but are not limited to, the degree of prior sediment enrichment, hydrologic pattern (i.e. continuously flooded versus periodic dryout), forms and concentrations of phosphorus in soil, minerals, inflow water chemistry, oxidation-reduction potential, vegetation conditions, and management activities (DeBusk and Kharbanda 2013).

Between Water Years 2002 and 2012, STA 2 experienced dryout conditions in at least five (5) water years, with approximate durations ranging from 1 to 5 months. STA 3/4 experienced dryout conditions one time since Water Year 2005, with a duration of less than one month. Below are detailed descriptions of dryout conditions for STA 2 and STA 3/4.

STA 2

Cell 1 experienced dryout conditions for approximately 3 months from mid-April 2001 through July 2001. Cell 1 experienced dryout conditions for approximately 5 months from early December 2001 through April 2002. Cell 1 experienced dryout conditions for approximately 3 months from March through May 2009. Cell 2 experienced dryout conditions for approximately 3 months from March through May 2009. Cell 1 and parts of Cell 2 experienced dryout conditions for approximately 1 month during Water Year 2011. Cell 4 experienced dryout conditions for several months in Water Year 2011, but this was related mainly to Compartment B construction activities. Cell 1 experienced dryout conditions for a brief period in June 2011. Cell 4 experienced dryout conditions for several months in Water Year 2012 related mainly to Compartment B construction activities.

STA 3/4

The Water Year 2011 dry season resulted in dryout conditions in all cells of STA 3/4 for approximately 1 month (June 2011). The dryout of SAV resulted in the near total loss of live vegetation.

Figure 3-9 STA Optimized Conditions (courtesy SFWMD presentation)

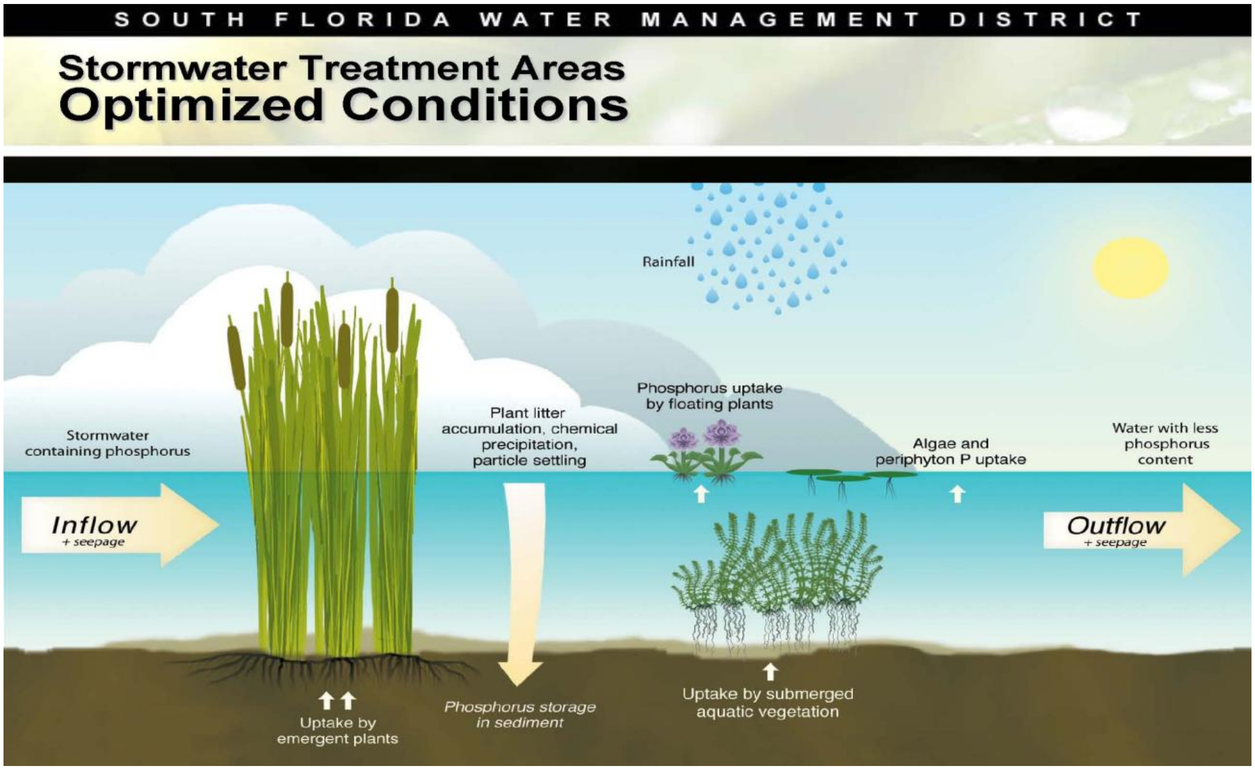


Figure 3-10 STA Dry-Out Conditions (courtesy SFWMD presentation)

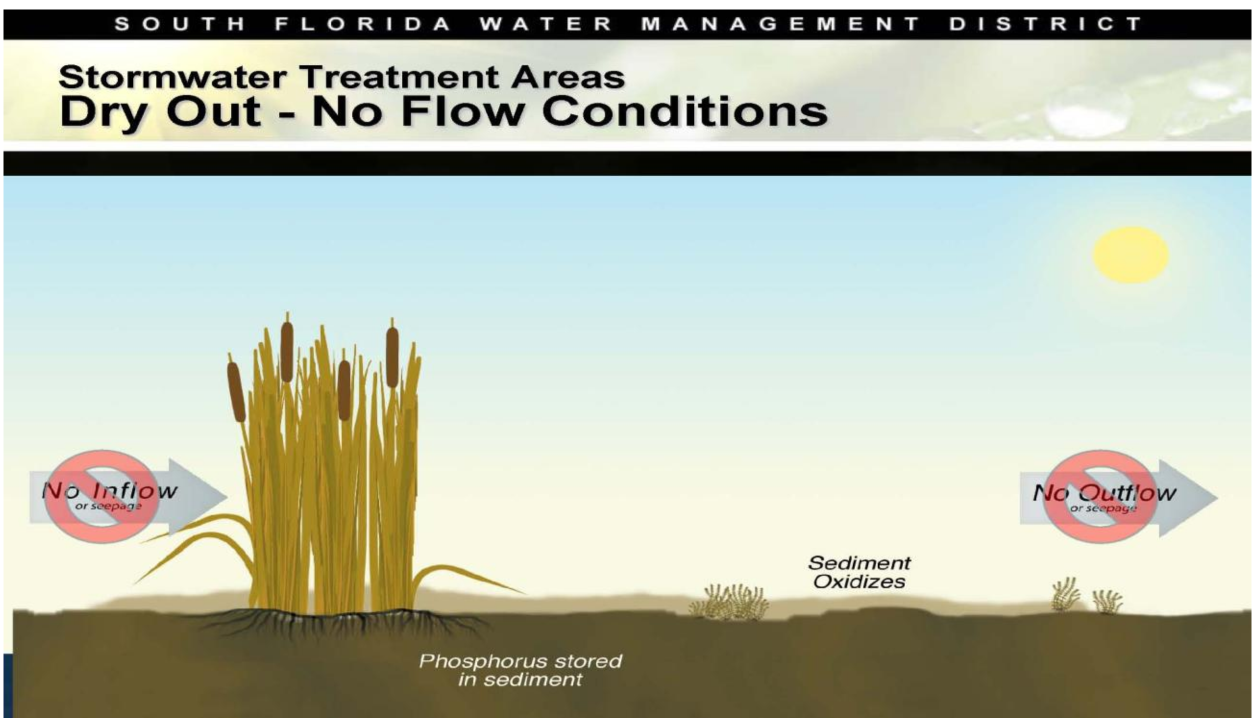
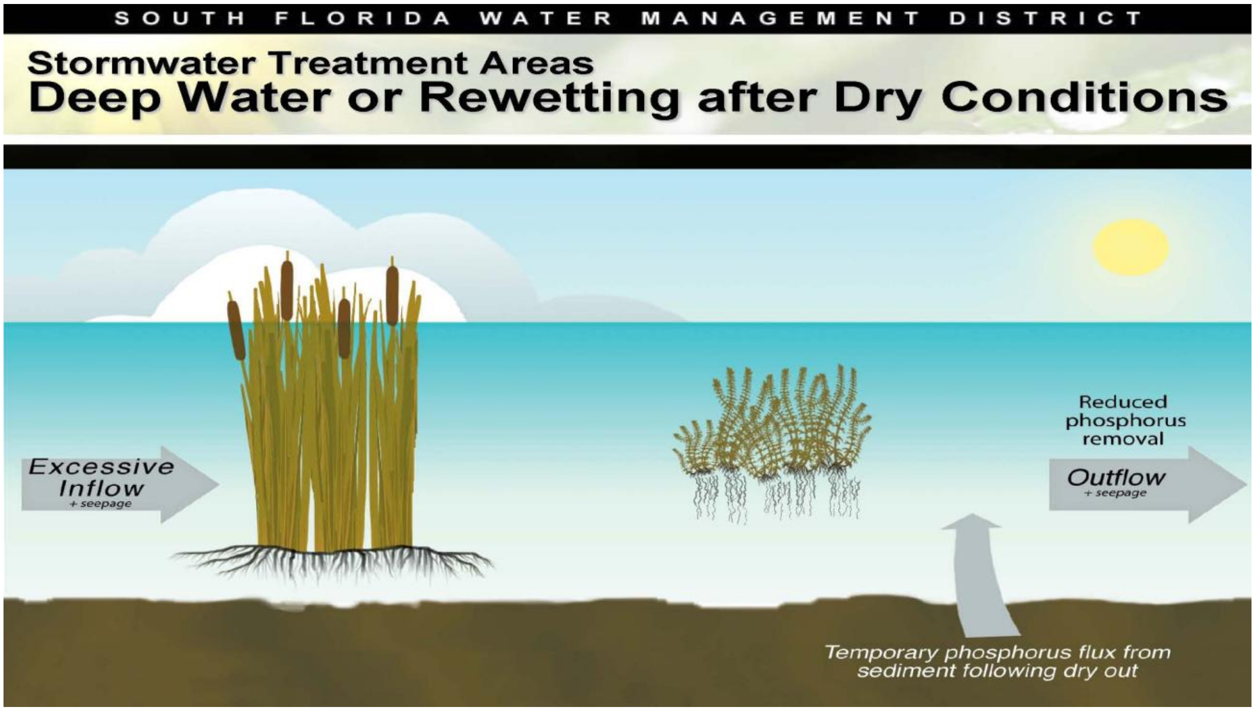


Figure 3-11 STA Re-Wetting after Dry Conditions (courtesy SFWMD presentation)



3.6 WATER QUALITY

Historically, the Everglades was an oligotrophic (or low nutrient) system. Therefore, the increased levels of nutrients present in portions of the system today have resulted in an imbalance in the native flora and fauna, for example, cattails and other invasive species displacing native sawgrass. Currently, nutrient inputs into the Everglades come primarily from agricultural fertilizers and decomposition of the peat soils, which is accelerated by continued agricultural use. While the increased concentrations of nitrogen, phosphorus, and other nutrients are a concern in the EPA, historically vegetation growth in the Everglades was limited by the comparative lack of bioavailable phosphorus. Thus, phosphorus is a parameter of particular concern in the water of Lake Okeechobee, the EAA, and the EPA.

Agricultural best management practices (BMPs) were implemented in the EAA in the 1990s, with the result of improving water quality. However, this area remains a primary source of pollutants for the WCAs. The WCAs form the remnant wetland communities for the northern section of the Everglades system. Water moving south from Lake Okeechobee and EAA is pumped through the STAs into WCAs, which are isolated by a series of levees and pump stations. Construction of STAs upstream of the WCAs serves to improve water quality conditions through time.

The focus of the water quality improvements in the Everglades is to reduce the total phosphorus concentrations in the water entering into the EPA marsh. Water quality standards are established to protect the designated use of a waterbody. The EPA waters have been designated as Class III which has the designated use of "recreation, propagation, and maintenance of healthy, well-balanced population of fish and wildlife" (62.302.540 FAC). The numeric total phosphorus criterion for Class III waters in the EPA as established in 62- 302.540 FAC is 10 parts per billion (ppb) measured as a long-term geometric mean. Achievement of the 10 ppb criterion in the Refuge and WCAs 2 and 3 is dependent on the total phosphorus (TP) concentrations in the water leaving the EAA. The 10 ppb criterion is applied using an achievement methodology that takes into account spatial and temporal variability, which is described below.

Achievement of the criterion in impacted and unimpacted areas of the Refuge, WCA 2 and WCA 3 is determined based upon data from stations that are evenly distributed and located in freshwater open water sloughs similar to the areas from which data were obtained to derive the phosphorus criterion. Determining achievement of the criterion is based on data collected monthly from the network of monitoring stations in both the impacted and unimpacted areas. The waterbody is assessed for attainment of the criterion as determined by a four-part test. In order to provide protection against imbalances of aquatic flora or fauna, the following provisions must all be met:

a. The 5-year geometric mean averaged across all stations is less than or equal to 10 ppb;
b. The annual geometric mean averaged across all stations is less than or equal to 10 ppb for 3 of 5 years;
c. The annual geometric mean averaged across all stations is less than or equal to 11 ppb; and
d. The annual geometric mean at all individual stations is less than or equal to 15 ppb.

Assessment of the phosphorus criterion within the Everglades indicates that the 4-part test is typically met in the unimpacted portions of each WCA, while the impacted portions of each WCA fail one or more parts of the test and therefore exceed the criterion. (SFWMD 2012).

3.6.1 PROJECT SITE

Water quality data at the project site are not available, but is anticipated to be similar to that of other fallow cropland in the EAA. It is reasonable to assume that phosphorus levels in the soil and in runoff would be lower than active agricultural activities, but higher than sites not previously farmed.

3.6.2 STA 2 AND STA 3/4

The original STA 2 consisted of three treatment cells (1, 2, & 3) with approximately 6,400 acres of effective treatment area and began operation in 2000. The treatment area was expanded by approximately 1,900 acres with the construction of Cell 4, which was flow capable by December 2006. However, this cell went off-line in Water Year (WY) 2010 (water budget standard duration measured between May 1, 2009 and April 30, 2010) for Compartment B construction. Compartment B construction was completed in December 2011 and was permitted to operate in September 2012, adding approximately 7,000 acres of treatment area. The STA 2/Compartment B complex has a total of eight treatment cells, five flow-ways, and a total effective treatment area of approximately 15,000 acres. (**Figure 3-6**).

STA 3/4 consists of six treatment cells (1A, 1B, 2A, 2B, 3A and 3B) and the Periphyton-based STA (PSTA) Implementation Project cells (Upper SAV, Lower SAV and PSTA). STA 3/4 has 16,300 acres of effective treatment area and began operation in 2003 (**Figure 3-7**).

Average annual TP concentrations of inflows to and outflows from STA 3/4 and STA 2 are shown in **Table 3-1**. Since STA 3/4 began operation in October 2003, it has treated approximately 3.7 million acre-feet (ac-ft) of runoff, retaining 440 metric tons (mt) of TP, and reducing TP concentration from 114 parts per billion (ppb) to 18 ppb. Since STA 2 began operation in October 2003, it has treated approximately 2.7 million acre-feet of runoff, retaining over 269 metric tons of TP, and reducing TP concentration from 103 ppb to 22 ppb flow weighted mean concentration (FWMC). While improvements have been observed, these STA outflow concentrations still exceed the WQBEL criterion of 13 ppb, which is the concentration required at the STA discharge in order to prevent further phosphorus enrichment in the EPA.

Table 3-1 STA performance for the period of record from STA operational start date - WY2012.

STA	Start Date	Inflow Volume (ac-ft)	Inflow TP FWMC to date (ppb)	TP retained to date (mt)	Outflow TP FWMC to Date (ppb)
STA 2*	June 1999	2,764,250	103	269	22
STA 3/4	Oct. 2003	3,719,561	114	440	18

*Data for the Compartment B expansion is not included as it was not completed until WY2013.

Due to the complexity of the STAs, the many operational challenges, and the demand to achieve and sustain low TP outflow concentrations, the SFWMD has performed and continues to conduct scientific investigations and research with the goals of enhancing knowledge of the complex treatment systems, the factors affecting performance, and the various TP removal mechanisms in the STAs. The research projects and results are presented annually in the South Florida Environmental Reports (SFERs) (available at www.sfwmd.gov/sfer). It is evident, however, that maintaining minimum stages to keep the STAs hydrated and to ensure the viability of EAV and SAV, and regulating inflows to minimize high hydraulic loading rates improves their performance.

3.6.3 WATER CONSERVATION AREAS

The geometric mean of measured TP concentrations (in ppb) in the WCAs over the 2005 to 2011 period of record is summarized in **Table 3-2**. The inflow and outflow concentrations are based on total inflows and total outflows to the WCA. As the outflow from the STA is discharged in the canal, the treated water mixes with the untreated water in the canal, and can enter into the WCA. As not all of the canal water is treated by the STA and not all of the treated water enters the WCAs, the TP concentrations in the outflow from the STA are different from the concentrations in the inflow in the WCAs. **Figure 3-12** and **Figure 3-13** show the location of the water quality monitoring stations in WCA 2A and WCA 3A, respectively.

Table 3-2 WY2005 to WY2011 Geometric Mean TP Concentrations (ppb)

WCA	Inflow	Interior	Outflow
WCA 2A	21.1	12.0	13.9
WCA 3A	23.0	7.5	12.8

Decreases in interior marsh TP concentrations in recent years have been observed for WCA 2A and WCA 3A (**Table 3-3**). The continued decreases in TP concentration observed in WCA 2 and WCA 3 likely reflect recovery from the recent climatic extremes, improved treatment of the inflows to these areas (which is supported by similar decreases in inflow concentrations), and improved conditions in the impacted portions of the marsh (SFWMD 2012). This includes the area downstream of the S-10 structures located along the L-39 levee between WCA 2A and WCA 1, which is one of the area’s most highly impacted by historical phosphorus enrichment (**Figure 3-14**). This area is also where the quantity of discharge has been significantly reduced and the quality of the discharge has improved since STA 2 began operation.

Figure 3-12 Location and classification of water quality monitoring stations in WCA 2

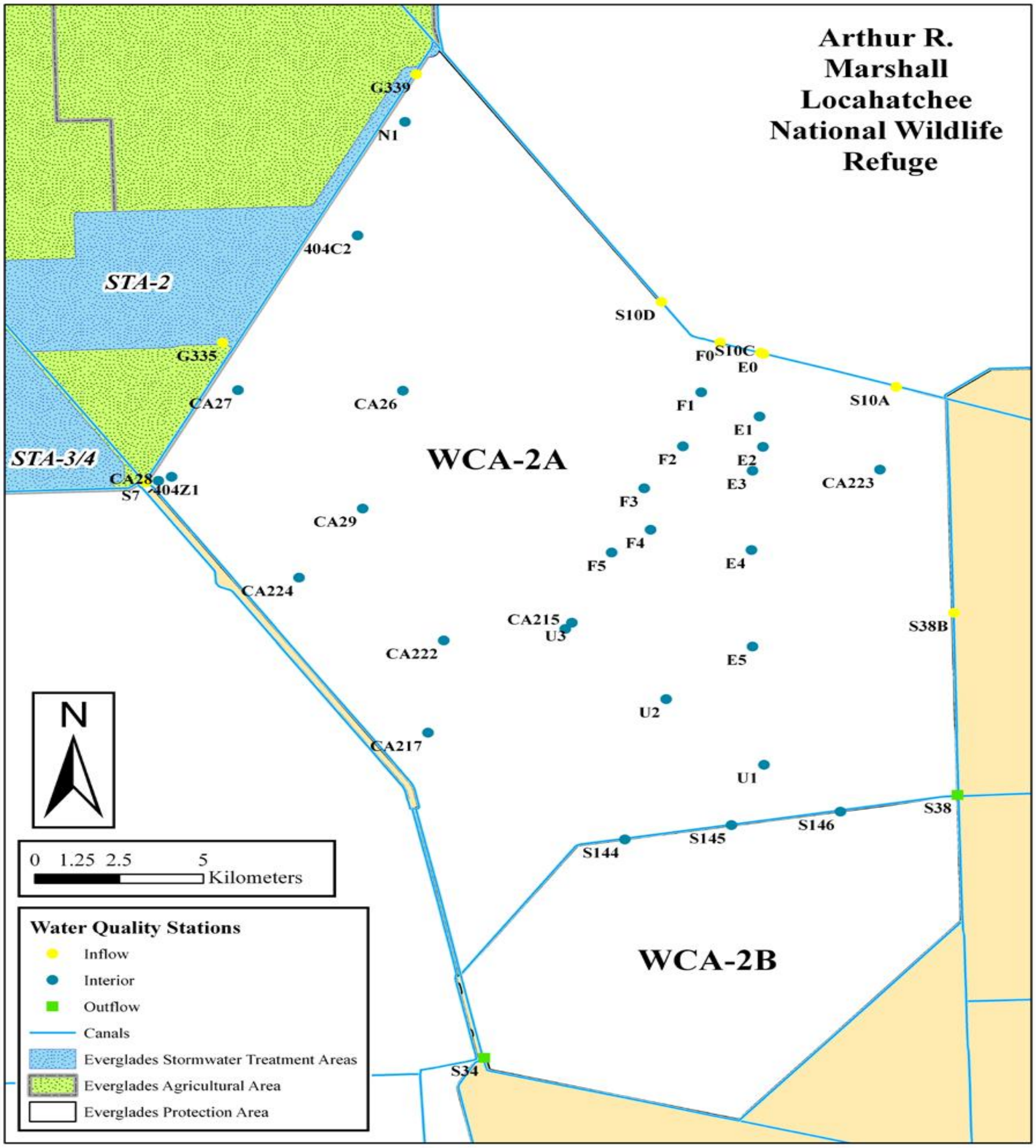


Figure 3-13 Location and classification of water quality monitoring stations in WCA 3

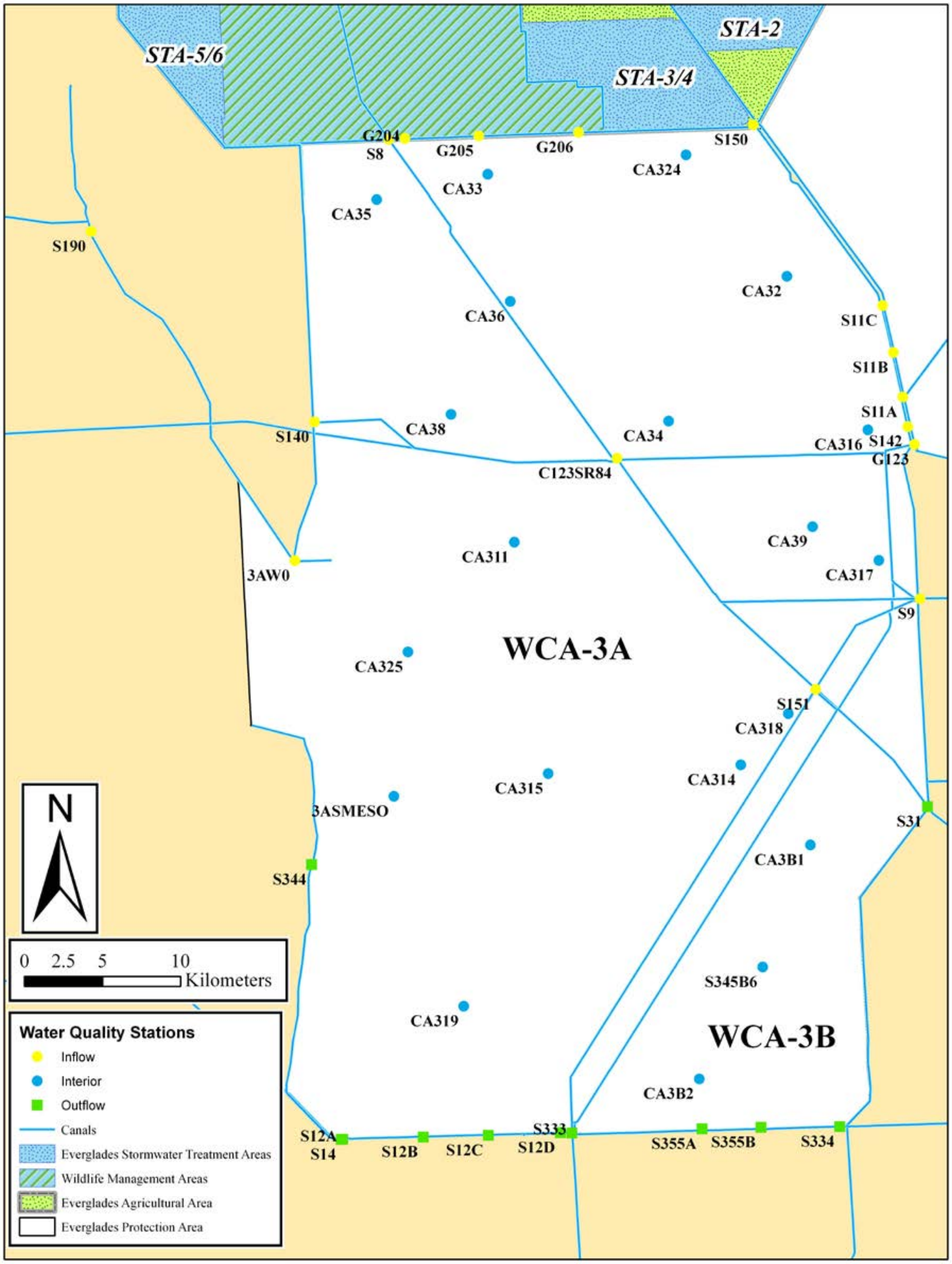


Figure 3-14 Phosphorus Impacted Areas in the Everglades Protection Area

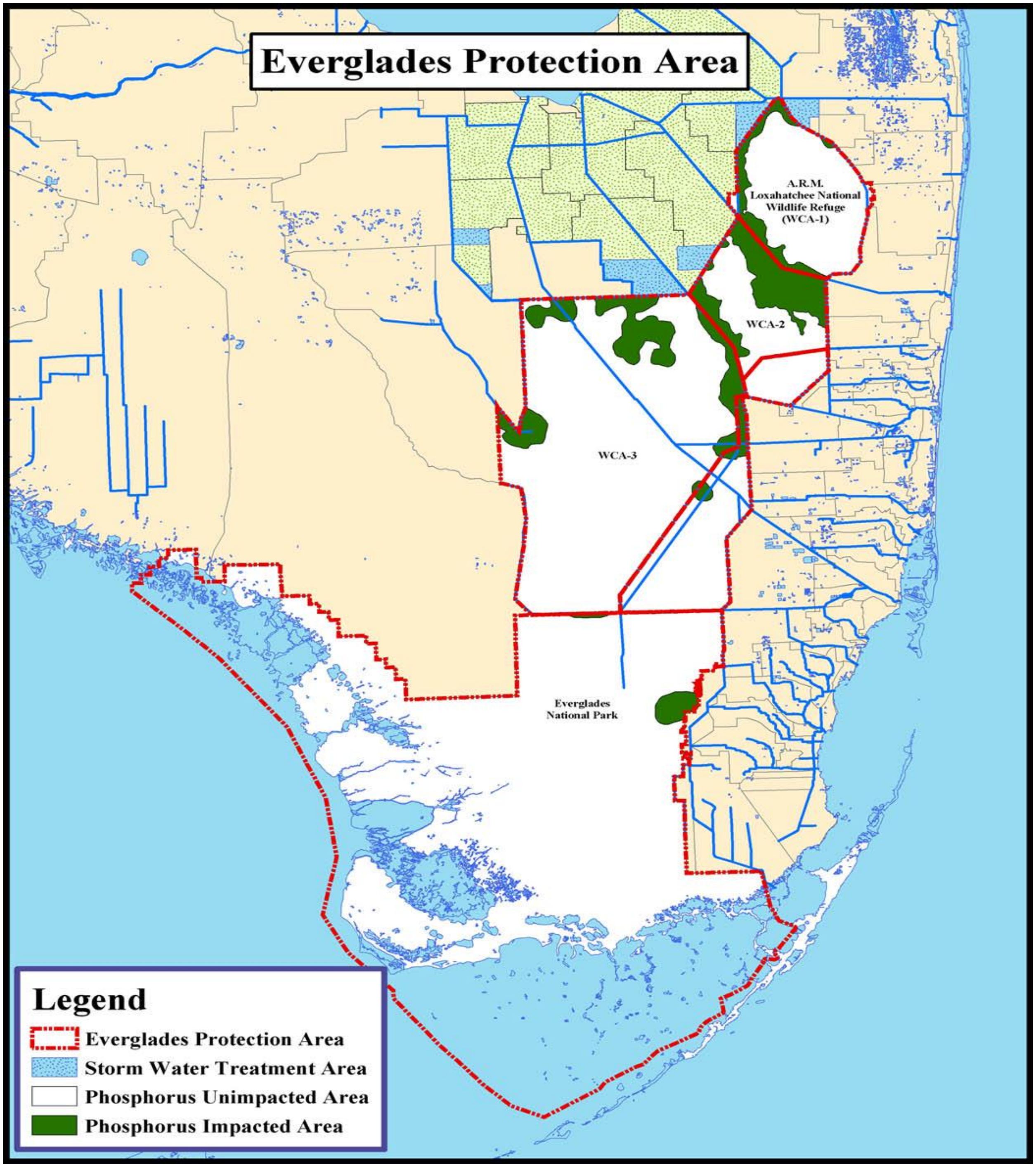


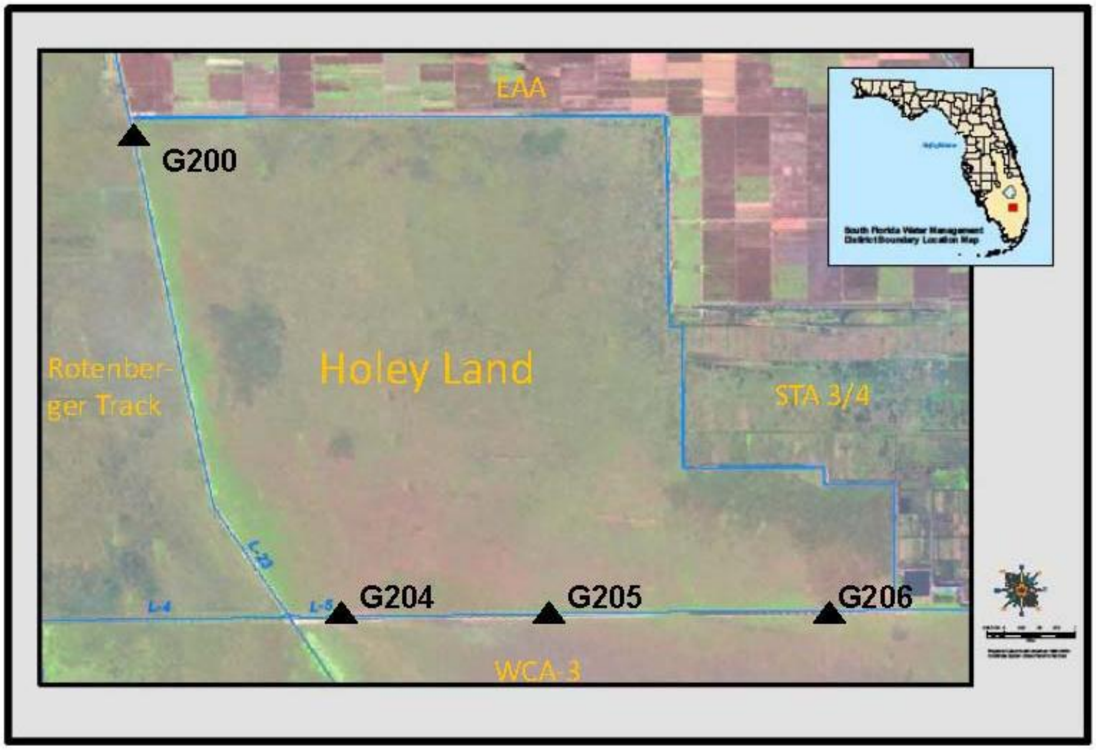
Table 3-3 Total phosphorus concentrations (ppb) for the periods WY1979-WY1993, WY1994-WY2004, WY2005-2011 and WY2012

		Geometric Mean		Median	
		WCA 2A	**WCA 3A**	**WCA 2A**	**WCA 3A**
Inflow	1979-1993	69.8	37.4	68.0	37.0
	1994-2004	45.0	31.5	49.0	30.0
	2005-2011	21.1	23.0	18.0	21.0
	2012	15.3	21.9	13.5	21.0
Interior	1979-1993	16.2	10.2	13.0	10.0
	1994-2004	16.9	8.1	14.0	7.0
	2005-2011	12.0	7.5	10.0	7.0
	2012	8.9	6.3	8.0	6.0
Outflow	1979-1993	23.2	12.1	23.0	11.0
	1994-2004	17.6	10.1	17.0	10.0
	2005-2011	13.9	12.8	13.0	11.3
	2012	14.0	14.7	13.0	13.0

3.6.4 HOLEY LAND WILDLIFE MANAGEMENT AREA

Since 2008, there have been no surface water inflows to or outflows from Holey Land. Due to the lack of surface water flows, SFWMD has collected limited water quality samples from ponded water at the G-204, G-205, and G-206 (**Figure 3-15**). The results (October 1, 2010 to September 30, 2011) show total phosphorus concentrations ranging from 20 ppb to 32 ppb, with an average concentration of 25 ppb at G-200, 48 ppb to 206 ppb, with an average concentration of 117 ppb at G-204, 30 ppb to 72 ppb, with an average concentration of 48 ppb at G-205, and 12 ppb to 31 ppb, with an average concentration of 24 ppb at G-206- (SFER 2013). Higher nutrient levels were observed at G204, which dries out more frequently than G205 and G206, due to the higher topography of the location.These values are indicative of water column concentrations within these pools and may not be representative of the marsh water quality.

Figure 3-15 Holey Land Water Quality Monitoring Locations



3.7 VEGETATION

3.7.1 PROJECT SITE

The project site contains 16,517.9 acres of land, of which 14,656.9 acres are waters of the US and 1,861 acres are uplands. The waters of the US consists of 9,950.4 acres of mixed scrub shrub wetlands (exotic regraded wetlands), 203.2 acres of exotic scrub shrub wetlands (exotic dominated wetlands), 3,908.5 acres of herbaceous freshwater marsh wetlands (scraped area wetlands), 97.6 acres of borrow areas, and 498.1 acres of channelized waterway (other surface waters).

The uplands consist of existing levees and areas that have been previously filled to store rock material and muck soils. The exotic degraded wetlands (9,950.4 acres) are areas that previously contained sugar cane vegetation. Since active sugarcane cultivation has ceased in 2009, these wetland areas have gone fallow. Sugar cane vegetation is no longer present and wetland vegetation has recruited back into the area. These areas, which are in an altered condition, contain plant species such as Carolina willow or often just referred to as willow (Salix caroliniana), wand goldenrod (*Solidago stricta*), bushy broomsedge (*Andropogon glomeratus*), salt bush (*Baccharis glomerulifolia*), elephant grass (*Pennisetum purpureum)*, primrose willow

(*Ludwigia peruviana*) and cattail (*Typha spp.*). Standing water was not observed in these areas during a site visit in October 2012.

The 203.2 acres of wetland that were high quality depressional wetlands in 2005 are now in a highly degraded condition with 90% nuisance and exotic species such as Elephant grass and castor bean (*Ricinus communis*). These areas did not contain standing water during a site visit in October 2012. [See Florida Department of Environmental Protection (FDEP) field trip report in Appendix C for details.] The 3,908.5 acres of freshwater marsh wetlands were previously scraped down during construction activities for the A-1 Reservoir. These areas are considered higher quality wetlands as compared to the exotic dominated wetland areas and exotic degraded wetlands because they contain a dominance of native plant species including water-primrose (*Ludwigia peruviana*), bushy aster (*Aster dumosus*), marsh fleabane (*Pluchea rosea*), flat-sedge (*Cyperus spp.*), jointed spikerush (*Eleocharis interstincta*), and water-hyssops (*Bacopa caroliniana*). Also these areas contained standing water during the site visit in October 2012.

The waters of the US include 96.7 acres of borrow areas and 498.1 acres of channelized waterway. Spatter-dock (*Nuphar spp*.) and water lettuce (*Pistia Stratiotes*) were found floating on the surface of the canals and ditches. Refer to Chapter 5 to review the SFWMD's Uniform Mitigation Assessment Methodology (UMAM) wetland function and value scores for existing site conditions.

3.7.2 STA 2 AND STA 3/4

Cells within the STA's are designed for either EAV or SAV and open water areas. The dominant submerged aquatic vegetation species include *Najas* sp. (water-nymph) and *Chara* (muskgrass), a gray-green branched multicellular algae, while the dominant emergent aquatic vegetation is cattail (*Typha domingensis*).

Maintaining water depths at levels optimal to cattail growth and survival is an important management strategy in the STAs. Changes in hydrologic regimes in a marsh can have subtle to drastic effects on cattail (Chen et al., 2010). Cattail species can be eliminated under extended periods of deeper water level conditions (Appelbaum, 1985 as cited in Chen 2013; Sojda and Solberg, 1993 as cited in Chen 2013). Extended deepwater conditions can cause the formation of cattail floating mats in the STAs (Chen et al., 2010). Heavy hydraulic loading, particularly during storm events, has impacted cattail coverage and density in EAV cells.

Dry-outs have less effect on cattails than SAV as cattails can survive short periods of dry-out. Lowering water levels to near ground level for a moderate time improves cattail recruitment and establishment (Chen 2013); however long periods of complete dry-out can also result in cattail mortality. In SAV cells, dryout events typically have adverse effects on the vegetation and potentially alter the community characteristics following rehydration. Dry-out of SAV cells leads to die off of the SAV and the associated periphyton communities essential to phosphorus sequestration. For example, an STA 3/4 central flow-way dryout/re-flood event in 2011 resulted in a dramatic change in the SAV community from a water-nymph and muskgrass co-dominated to a muskgrass dominated system. (DeBusk and Kharbanda 2013)

3.7.3 WATER CONSERVATION AREAS 2A AND 3A

Almost all of the WCAs are grass-dominated wetlands interspersed with tree islands (hammocks) and Carolina willow strands. Tree islands are a unique feature of the Everglades ecosystem. In general, there are two recognizable types of basin wetland communities present in the WCAs:

1. Sawgrass ridge composed of primarily of sawgrass (*Cladium jamaicense*) with cattail (Typha spp.), maidencane (*Panicum hemitomon*), arrowhead (*Sagittaria* sp.), pickerelweed (*Pontederia cordata*), Carolina willow, buttonbush (*Cephalanthus occidentalis*), wax myrtle (*Myrica cerifera*), and saltbush.
2. Slough communities, composed of spikerush (*Eleocharis* spp.), white water lily (*Nymphaea odorata*), SAV and periphyton.

There are also forested wetlands within the WCAs, which include tree islands. The composition of tree island plant communities vary from island to island but a relatively small number of plant communities are widely distributed across the landscape of the central Everglades. Despite some north–south landscape stratification in tree islands, at least six identified canopy communities are present in all tree island that were surveyed, which is an indication that the forest canopy of elevated tree islands is relatively similar throughout the central Everglades. The six canopy communities are:

1) Fig Canopy
2) Diverse Forest
3) Pond Apple Canopy
4) Willow Mix
5) Willow Canopy
6) Coco plum Canopy

The dominant canopy species identified fall into two broad categories: very flood intolerant species and species that tolerate a wide hydrologic range. The dominant species of the Fig and Diverse Forest communities, Ficus aurea, Schinus terebinthifolius, Cocoloba diversiflora, Bursera simaruba, and Celtis laevigata, were found in all island groups and in 29% of the plots surveyed. Most of the dominant species of these two canopy communities are species known to be flood intolerant with optimum annual hydroperiods of less than 60 days (Sah 2004). Species with broad hydrologic tolerances (200 to 310 days; Sah 2004) include Annona glabra, Salix caroliniana, and Chrysobalanus icaco, which were dominant in the Pond Apple, Willow Canopy, and Coco Plum plant communities and recorded in 77% of the plots. Chrysobalanus icaco has a hydrologic tolerance of 50–240 days per year, one of the longest hydroperiod ranges of the common tree island species (Sah 2004).

In general, woody species with wide hydroperiod tolerances were more common than were species requiring shorter hydroperiods. Because of the highly altered hydrology caused by water management in the current Everglades, it is not clear whether this finding reflects a natural pattern of wetland forests or is the result of human-caused hydroperiod increases in the last several decades. The canopy communities of the tree island heads of the studies tree islands were qualitatively described in the 1970s and early 1980s and provide a partial idea of how the vegetation canopy communities have changed during the past 25 to 30 years (McPherson 1973; Alexander and Crook 1975; Zaffke 1981; Wetzel 2002a).

Although the vegetation descriptions are limited, the canopy communities located on islands in the middle of WCA 3A or 3B appear to have changed little in 25 years (Alexander and Crook 1975; Wetzel 2002a). Species richness was similar and the same species were present at both time periods. However, for two islands in southern WCA 3A the tree island canopy communities appear to have shifted toward a greater dominance of species with broad water tolerances. Comparison of the data from this study and descriptions from Alexander and Crook (1975) and McPherson (1973) suggest that canopy species such as A. glabra and S. caroliniana increased and other water intolerant species, such as Ficus aurea, Myrsine guianensis, and Persea borbonia became less common on these two islands. If such a shift in canopy species has occurred on these two islands it may be the result of increased water levels caused by the levees that have impounded water in southern WCA 3A since the 1960s. Extreme hydrologic patterns, a history of human camps, and severe fires are important environmental drivers for tree island head forest composition, but there are other possible factors not measured that could influence forest composition, including competitive exclusion from non–native species, patterns of seed dispersal (Gawlik and Rocque 1998), and interspecific competition. In addition, the data cannot reflect the loss of plant species (or community associates) that occurred prior to the sampling efforts.

High nutrient concentrations have resulted in widespread changes to the ecology of the Everglades, including invasion of cattail. The proliferation of cattail in the Everglades is attributed to increased phosphorus levels in the soil and increased water depth and duration of flooding (Newman et. al. 1998). Monospecific stands of cattail have replaced the historic sawgrass marsh ridge and slough landscape over nearly 12,500 hectares (30,888 acres) in the Everglades (SFWMD 2012).

Vegetation maps provided in the following sections were produced by the SFWMD utilizing color infrared aerial photography. Data sets were ground-truthed and vegetation types delineated and classified using the Vegetation Classification for South Florida Natural Areas (Rutchey et al. 2006).

Major plant communities in WCA 2A now consist of remnant tree islands, open water sloughs, large expanses of sawgrass, and sawgrass intermixed with dense cattail stands. Remaining tree islands are found primarily at higher ground level elevations, located in the northwest corner of WCA 2A. Remnant tree islands, dominated primarily by Carolina willow, are found scattered throughout the central and southern sections of WCA 2A. Cattail distribution in WCA 2 reflects 4,400 acres in which cattails represent more than 50% of the vegetation coverage and 24,000 acres of mixed or scattered cattail (<50% coverage) present in the northeast portion of WCA 2A (USACE 2009).

Several studies conducted within WCA 2A show that cattail out-compete sawgrass in their ability to absorb excess nutrients with increased cattail production during years of high nutrient inflows (Toth, 1988; Davis, 1991). Cattail is considered a high nutrient status species that is opportunistic and highly competitive, relative to sawgrass, in nutrient-enriched situations (Toth, 1988; Davis, 1991). Davis (1991) concluded that both sawgrass and cattail increased annual production in response to elevated nutrient concentrations, but that cattail differed in its ability to increase plant production during years of high nutrient supply.

The community structure and species diversity of Everglades vegetation located north of I-75 (WCA 3A North) is very different from the wetland plant communities found south of I-75 (WCA 3A South). Improvements made to the Miami Canal and the impoundment of WCA 3A by levees have over-drained the north end of WCA 3A and shortened its natural hydroperiod. These hydrological changes have increased the frequency of severe peat fires that have resulted in loss of tree islands, aquatic slough, and wet prairie habitat that were once characteristic of the area. Today, northern WCA 3A is largely dominated by sawgrass and lacks the natural structural diversity of plant communities seen in southern WCA 3A.

Over-drainage of the northwestern portion of WCA 3A has allowed the invasion of a number of terrestrial species such as saltbush, dog fennel (*Eupatorium sp*.), and broomsedge (*Andropogon* *glomeratus*). Melaleuca (*Melaleuca quinquenervia*) has become well-established in the southeastern corner of WCA 3A, and is spreading to the north and west.

Vegetation located in the central and southern portion of WCA 3A represents some of the best examples of original Everglades habitat left in South Florida. This region of the Everglades appears to have changed the least since the 1950s, and contains a mosaic of tree islands, wet prairies, sawgrass stands, and aquatic sloughs.

A comparison of vegetation in WCA 3 vegetation maps from 1995 to 2004 (SFWMD 2011) indicate an increase in sawgrass/shrub by 48 percent (9,566 acres to 14,179 acres, 30 percent increase in broadleaf marsh (2,775 acres to 3,593 acres), while floating marsh decreased by 37 percent (8,948 acres to 5,632 acres) (See **Figure 3-16**). Most significant may be the trend in cattail coverage which increased 38% within WCA 3, representing a state change from historic ridge and slough patterns (SFWMD 2011 and 2013) (**Figure 3-17**).

3.7.4 HOLEY LAND WILDLIFE MANAGEMENT AREA

The vegetation community structure was historically dense sawgrass with scattered wetland tolerant shrubs and sloughs (Davis, 1943); however, anthropogenic alterations of the hydropattern have caused significant shifts in the plant community structure (Cornwell and Hutchinson, 1974). Wet prairie and slough vegetative habitats are present in the northeast and southwest reaches. Carolina willow is encroaching into the marsh along the Holey Land's western and southern boundaries.

Cattails are also prevalent throughout the Holey Land. The ground elevation within Holey Land varies as much as four feet. This elevation range is primarily the result of muck fires burning away organic soil during extreme dry periods. Extended high water levels in Holey Land can drown out typical marsh species in these deep pockets, creating an opening in the landscape susceptible to invasion by cattail (Newman et al. 1998). The FWCC performs cattail monitoring in Holey Land (SFWMD, 2011). The results of the 2011 survey estimate that 18% (6,300 acres) of the area is covered by cattail. This indicates an increase in estimated cattail coverage from 2010 (which was 10% of the area); however, it is still significantly less than what was estimated in 2004 at 27% coverage of the area.

Figure 3-16. Dominant vegetation types in found in 1995 and 2004 WCA 3 vegetation mapping (SFWMD 2011).

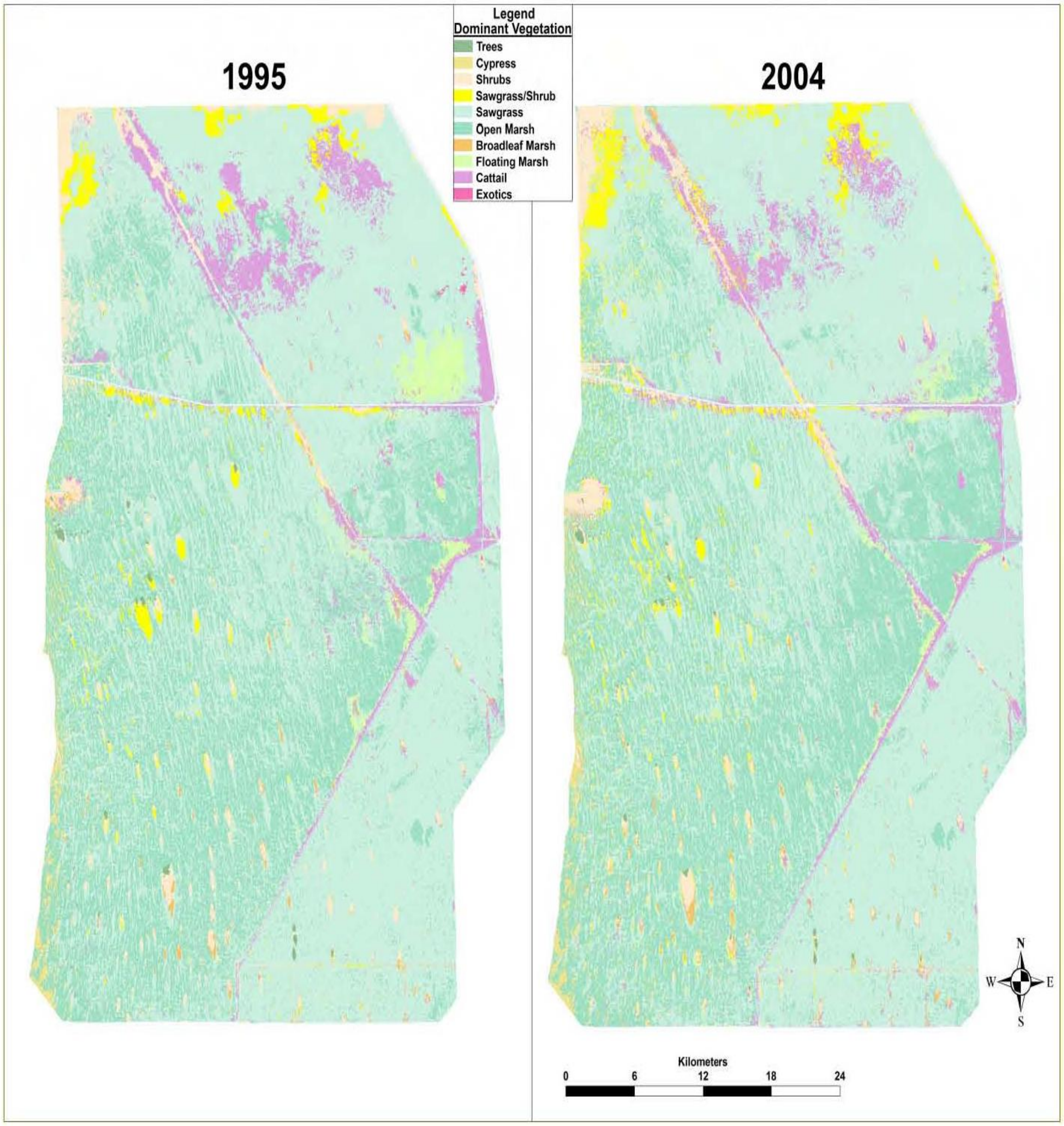
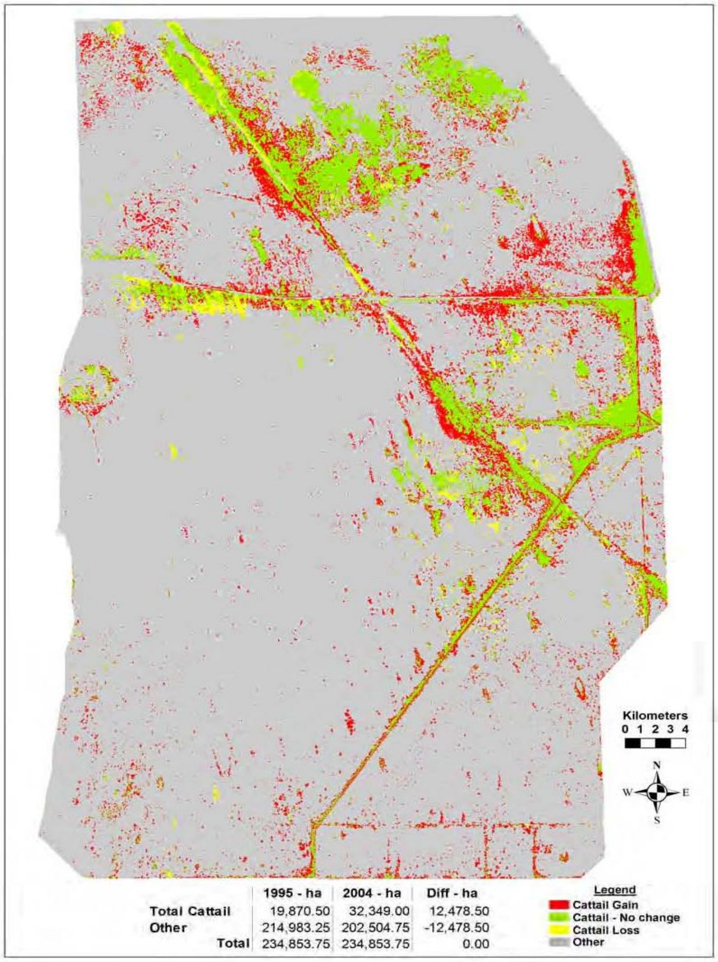


Figure 3-17 Map depicting gain, loss, and no change in cattail coverage within WCA 3



3.8 FISH AND WILDLIFE

3.8.1 GENERAL FISH AND WILDLIFE SPECIES

3.8.1.1 Overall area

Aquatic macroinvertebrates form a vital link between the algal and detrital food web base of freshwater wetlands and the fishes, amphibians, reptiles, and wading birds that feed upon them. Important macroinvertebrates of the freshwater aquatic community include crayfish (*Procambarus alleni*), riverine grass shrimp (*Palaemonetes paludosus*), amphipods (*Hyallela aztecus*), Florida apple snail (*Pomacea paludosa*), Seminole ramshorn (*Planorbella duryi*), and numerous species of aquatic insects (USACE 1999a).

Small freshwater marsh fishes are also important processors of algae, plankton, macrophytes, and macroinvertebrates. Marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Common small freshwater marsh species include the golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), oscar (*Astronotus ocellatus*), eastern mosquitofish (*Gambusia holbrookii*), and small sunfishes (*Lepomis* spp.) (USACE 1999a). The density and distribution of marsh fish populations fluctuates with seasonal changes in water levels. Populations of marsh fishes increase during extended periods of continuous flooding during the wet season. As marsh surface waters recede during the dry season, marsh fishes become concentrated in areas that hold water through the dry season, such as alligator holes, limestone solution holes, and longer-hydroperiod marshes and sloughs. Concentrated dry season assemblages of marsh fishes are more susceptible to predation and provide an important food source for wading birds (USACE 1999a).

Numerous sport and larger predatory fishes occur in deeper canals and sloughs. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), yellow bullhead (*Ameiurus natilis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (USACE 1999a). Larger fish are an important food source for raptors and other birds of prey, wading birds, alligators, otters, raccoons, and mink.

The freshwater wetland complex supports a diverse assemblage of reptiles and amphibians. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Rana grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirela*), and green tree frog (*Hyla cinerea*) (USACE 1999). Amphibians represent an important forage base for wading birds, alligators, and larger predatory fishes (USACE 1999a).

Common reptiles of freshwater wetlands include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 1999a). The alligator was historically most abundant in the peripheral Everglades marshes and freshwater mangrove habitats, but is now most abundant in canals and the deeper slough habitats of the central Everglades, the STAs, WCAs and the Holey Lands. Drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited the occurrence of alligators in these habitats (Mazzotti and Brandt 1994).

The freshwater wetlands of the STAs, WCAs and the Holey Land are noted for their abundance and diversity of colonial wading birds. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green-backed heron (*Butorides striatus*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Ajaia ajaja*), and wood stork (*Mycteria americana*) (USACE 1999a).

The Everglades National Park (ENP) historically supported the largest number of nests in the Greater Everglades, but in recent decades the majority of nesting has occurred further inland in the WCAs. In 2012 an estimated 24,191 nests (92% of all south Florida nests) were initiated either in the WCAs or ENP. This estimate is 40% lower than the decadal average and 66% lower than in 2009 when a record high of 73,096 nests was recorded. Most other regions of south Florida experienced similar declines in nest numbers during 2012. (Cook and Kobza 2012). Wading bird populations in the Everglades are dynamic, changing constantly and are influenced by many other aspects (Russell *et al*. 2002). However, the most influential aspect is perhaps human habitat alteration; particularly those that change the natural hydrological conditions. Food availability is consider the most important factor limiting populations of wading birds in the Everglades (Frederick & Spalding 1994); however hydrology is the factor that ultimately determines the availability of food. The concept of too much/too little or just the right amount of water and the too late/too early or just at the right time seem to be of particular importance for wading birds. (Cook and Kobza 2012).

Mammals that are well-adapted to the aquatic and wetland conditions of the freshwater marsh complex include the rice rat (Oryzomys palustris natator), round-tailed muskrat, and river otter (Lutra canadensis). Additional mammals that may utilize freshwater wetlands on a temporary basis include the white-tailed deer (Odocoileus virginianus), Florida panther (Puma concolor coryi), bobcat (Lynx rufus), and raccoon (Procyon lotor). Additional information on Greater Everglades fauna is also contained within the South Florida Environmental Reports which are published annually by the SFWMD:

(http://my.sfwmd.gov/portal/page/portal/xweb%20about%20us/agency%20reports#previous_reports).

3.8.1.2 Project site

The A-1 project site contains habitat for a variety of fish and wildlife species. The previous farming activities on the site may have deterred some species from utilizing the site; however, since the site has been undisturbed for several years, the amount of wildlife utilization has since increased. A list of fish and wildlife species observed on the project site is shown in **Table 3-4**. Because the list of invertebrates including insects, spiders, ants and butterflies is so large, they were not included in the list.

Table 3-4 Fish and Wildlife Observed on the A-1 Project Site

Group	Common Name	Scientific Name	A-1
Mammals	Bobcat	Lynx rufus	x
	Eastern cottontail	*Sylvilagus floridanus*	x
	Grey fox	*Urocyon cinereoargenteus*	
	Marsh rabbit	*S. palustris*	x
	Raccoon	*Procyon lotor*	
	Coyote		x
	White tailed deer	*Odocoileus virginianus*	
Birds	Anhinga	*Anhinga anhinga*	x
	Barn owl	*Tyto alba*	x
	Barn swallow	*Hirundo rustica*	x
	Belted kingfisher	*Cercyle alcyon*	x
	Black-necked stilt	*Himantopus mexicanus*	
	Boat-tailed grackle	*Quiscalus major*	x
	Burrowing owl	*Athene cunicularia floridana*	x
	Cattle egret	*Bubulcus ibis*	x
	Common grackle	*Quiscalus quiscula*	
	Common ground dove	*Columbina passerina*	
	Common moorhen	*Gallinula chloropus*	x
	Common nighthawk	*Chordeiles minor*	x
	Common yellowthroat	*Geothlypis trichas*	x
	Crested caracara	*Caracara cheriway*	
	Double-crested cormorant	*Phalacrocorax auritus*	x
	Eastern meadowlark	*Sturnella magna*	x
	Eastern towhee	*Pipilo erythropthalmus*	
	Glossy ibis	*Plegadis falcinellus*	
	Great blue heron	*Ardea herodias*	
	Great egret	*Ardea alba (Casmerodius albus)*	x
	Green heron	*Butorides virescens*	x

	Killdeer	*Charadrius vociferus*	x
	Least tern	*Sternula atillarum*	
	Limpkin	*Aramus guarauna*	
	Little blue heron	*Egretta caerulea*	x
	Loggerhead shrike	*Lanius ludovicianus*	
	Mottled duck	*Anas fulvigula*	
	Mourning dove	*Zenaida macroura*	x
	Northern bobwhite	*Colinus virginianus*	
	Northern cardinal	*Cardinalis cardinalis*	
	Northern mockingbird	*Mimus polyglottos*	
	Osprey	*Pandion haliaetus*	
	Red-shouldered hawk	*Buteo lineatus*	x
	Red-tailed hawk	*Buteo jamaicensis*	
	Red-winged blackbird	*Agelaius phoeniceus*	x
	Roseate spoonbill	*Ajaia ajaja*	x
	Snowy egret	*Egretta thula*	
	Tricolored heron	*Egretta tricolor*	x
	Turkey vulture	*Cathartes aura*	x
	White ibis	*Eudocimus albus*	x
	White-eyed vireo	*Vireo grisseus*	
	White-tailed kite	*Elanus caeruleus*	
	Wood stork	*Mycteria americana*	x
	Yellow-crowned night-heron	*Nyctanassa violacea*	
Reptiles and Amphibians	American alligator	*Alligator mississippiensis*	x
	Cottonmouth	*Agkistodon piscivorus*	
	Pig frog	*Rana grylio*	x
	Southern cricket frog	*Acris gryllus dorsalis*	
	Southern leopard frog	*Rana sphenocephala*	
	Tree frogs	*Hyla* spp.	x
	Turtle	Family *Emydidae*	
	Two-toed amphiuma	*Amphiuma means*	
Fish	Bluegill	*Lepomis macrochirus*	
	Florida gar	*Lepisosteus platyrhincus*	x
	Largemouth bass	*Micropterus salmoides*	x
	Mosquitofish	*Gambusia affinis*	x
	Redear sunfish	*Lepomis microlophus*	x

* Fish and wildlife species were observed directly or were detected by observing sign such as tracks, vocalizations, scat, exoskeletons, etc.

3.8.1.3 Stormwater Treatment Areas

The STAs are becoming known as havens for birds and wildlife. During the 109th National Christmas Bird Count conducted in January 2009, a multi-agency team documented 92,600 birds; a total of 112 species at STA 5. These species includes limpkin, roseate spoonbill, wood stork, bald eagle, Everglades snail kite, purple gallinule, black-necked stilts, sandhill crane, and some rare birds such as short-tailed hawk and Cassin's kingbird. Thus, the constructed wetland systems provide abundant breeding and foraging habitats to birds and other wildlife.

3.8.1.4 Water Conservation Areas 2A and 3A and Holey Land Wildlife Management Area

The WCAs and Holey Land as a whole contain a number of important species whose existence, population numbers, and sustainability are markedly influenced by water levels. The American alligator, a keystone Everglades species, has rebounded in terms of population numbers since the 1960s when the reptile was placed on the endangered species list by the USFWS. Alligators, it is believed, play an important ecological function by maintaining "gator holes", or depressions, in the muck which are thought to provide refuge for aquatic organisms during times of drought and concentrates food sources for wading birds. High water during periods of nest construction, which occurs from June to early July (Woodward, et al., 1989), decreases the availability of nesting sites. If conditions become too dry, either naturally or through water management practices, water levels may fall too low to maintain gator holes, forcing the animal to seek other areas to survive.

Other important reptile species commonly encountered within the WCAs and Holey Land include a number of species of turtles, lizards, and snakes. Turtle species include the snapping turtle, striped mud turtle, mud turtle, cooter, Florida chicken turtle, and Florida soft-shell turtle. Lizards such as the green anole are found in the central Everglades, and several species of skinks occur more commonly in terrestrial habitats. Numerous snakes inhabit the wetland and terrestrial environments. Drier habitats support such species as the Florida brown snake, southern ringneck snake, southern black racer, scarlet snake, and two rattlesnake species. The eastern indigo snake, a federally-listed threatened species, and the Florida pine snake, a state species of special concern, may also exist in drier areas. Wetter habitats support more aquatic species such as the water snake, the green water snake, mud snake, eastern garter snake, ribbon snake, rat snake, and the Florida cottonmouth (McDiarmid and Pritchard, 1978).

Important amphibians known to occur in South Florida include the Everglades bullfrog, Florida cricket frog, southern leopard frog, southern chorus frog, and various tree frogs common to tree islands and cypress forests. Salamanders inhabit the densely vegetated, still or slow-moving waters of the sawgrass marshes and wet prairies. They include the greater siren and the Everglades dwarf siren. Toads such as the eastern narrow-mouth toad also occur within the WCAs.

Colonial wading birds utilize the WCAs and Holey Land as both feeding and breeding habitat. The most common species utilizing the WCAs include the white ibis, great egrets, snowy egrets, cattle egrets, great blue herons, tricolored herons, little blue herons, green herons, black-crowned night herons, yellow-crowned night herons, wood storks, and glossy ibis, with populations varying widely in relationship to seasonal water level fluctuations. Historically, white ibis has been the most abundant colonial wading bird species within the WCAs with the great egret as the second (Frederick and Collopy, 1988). The WCAs and Holey Land support additional aquatic avifauna, such as the limpkin, two species of bitterns, the anhinga, as well as a number of resident and migratory waterfowl.

The Everglades fish community is composed of a variety of forage fish important in the diet of many wading birds, sport fish, native species, and exotics introduced partly through aquaculture practices and the aquarium trade. Forage species include the Florida flagfish, bluefin killifish, least killifish, shiners, mosquito fish, and sailfin molly.

The WCAs provide a valuable sport fishery for South Florida. Many of the canals, notably along US 41, I-75, and in the L-35B and L-67A, provide valuable recreational fishing for largemouth bass, sunfish, oscar, gar, bowfin, catfish and other species. Generally, Everglades sportfish are harvested from the borrow canals that surround the marsh. As water levels in the canal and marsh rise, fish populations disperse into the interior marsh and reproduce with minimum competition and predation. As water levels recede, fish concentrate into the deeper waters of the surrounding canals, where they become available as prey for wildlife and fishermen.

Several game and non-game wildlife species occur within the wetland systems in the WCAs and Holey Land including: white-tailed deer, common snipe, and marsh rabbit. Blue-winged teal, mottled ducks, and other game waterfowl are found in the sloughs. Feral hogs may also be present in drier areas or on tree islands.

3.8.2 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

3.8.2.1 Overall Area

The federal endangered, threatened, and species of special concern list is maintained by the USFWS and the National Marine Fisheries Service (NMFS) in accordance with the Endangered

Species Act (ESA). In the ESA, "endangered" species are in danger of extinction throughout all or a significant portion of its range, "threatened" species are likely to become endangered within the foreseeable future throughout all or a significant portion of its range, and "species of special concern" might need concentrated conservation actions. A list of federally designated critical habitat for protected species is also maintained by the USFWS and NMFS in accordance with the ESA. The ESA defines "critical habitat" as 1) the specific areas within the geographical area occupied by the species at the time it is listed on which are found physical or biological features essential to the conservation of the species and which may require special management consideration or protection; and 2) specific areas outside of the geographical areas occupied by the species at the time it is listed upon a determination that such areas are essential for the conservation of the species. Listed species and designated critical habitat discussed are those that may be affected by the proposed project and the alternatives. A list of the federally protected species and critical habitat that may occur on the project site is shown in **Table 3-5**.

Table 3-5 List of Federally Protected Species and Critical Habitat may occur on the project site

Federal Listing Status **Common Name**	**Scientific Name**	**Designated Status**
Reptiles		
American alligator	*Alligator mississippiensis*	*Threatened
Eastern indigo snake	*Drymarchon coaris couperi*	Threatened
Birds		
Audubon's crested caracara	*Caracara plancus audubonii*	Threatened
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Endangered
Wood stork	*Mycteria Americana*	Endangered
Mammals		
Florida panther	*Puma concolor coryi*	Endangered

* Threatened due to Similarity of Appearance with the American crocodile

3.8.2.2 Project site

The project site currently supports habitat utilized by threatened or endangered species, in particular the eastern indigo snake, the Audubon's crested caracara, the wood stork, and the Florida panther.

Eastern indigo snakes were reported in the project area from 2006 – 2011. **Figure 3-18** is based on the FWS's GIS database and shows the locations of eastern indigo snake reported from within the A-1 project site and the surrounding EAA. Currently, the former agricultural lands have converted back to wetland vegetation. Since the eastern indigo snake is typically found in upland areas, it is anticipated that eastern indigo snakes may be found in and around the levees and berms. In the sugar cane fields of the former A-I Reservoir project site, eastern indigo snakes have been observed (including one mortality) during earthmoving and other construction-related activities.

The project site is located within a USFWS Audubon crested caracara consultation area. The USFWS SLOPES defines the primary protection zone for the species as 985 feet outward from a nesting tree with a secondary zone 6,600 feet from an active nesting tree. There are no known nest sites located within 6,600 feet of the project site, as the nearest nest, documented in 2007, is over 20 miles northwest. The nearest documented occurrence was 12.6 miles southwest of the project area. (**Figure 3-19**).

The freshwater wetlands serve as foraging habitat for the wood stork. Although the nearest active wood stork colony is located over 25 miles away, wood stork are observed on the site (**Figure 3-21**).

Within the project area, there has been no panther focus area (based on telemetry point density) designated. However, within a 10 mile buffer area, 19,688 acres have been identified as a primary panther zone and 101,350 acres have been identified as secondary panther zone (USFWS GIS database, 2012). Therefore, it is anticipated that panthers may hunt on the project site, but it is unlikely that they would use these areas for any extended length of time because of the lack of suitable long-term panther habitat (URS 2007). In addition, the site borders the eastern extent of the panther's secondary zone (**Figure 3-22**). No Florida panthers have been sighted on the property; however, they have been documented in the area (**Figure 3-23**).

3.8.2.3 Stormwater Treatment Areas 2 and 3/4

The eastern extent of STA 2 is within the core foraging area of four wood stork colonies, and the wood storks have been documented to utilize the wetlands within the both STAs. The southeast corner of STA 3/4 also falls within the 18.6 mile buffer area of a wood stork colony.

The levees and berms may provide habitat for the eastern indigo snake. Alligators are present within both STAs. Although it was originally anticipated that the Everglades snail kites would only forage in the STAs, there have been documented reports that the snail kites nested within STA 3/4 in 2011 and have begun nesting in STA 1E (USFWS GIS database, 2012).

3.8.2.4 Water Conservation Areas and Holey Land Wildlife Management Area

Federally protected species occurring in the WCAs include many of the protected species in the South Florida region including the American alligator, wood stork, Audubon's crested caracara, Everglades snail kite, Florida panther, and possibly the Eastern indigo snake. The WCAs also have designated critical habitat for the Everglades snail kite in WCA 2 and WCA 3, and support several successful nests.

3.8.2.5 Species Descriptions

3.8.2.5.1 American Alligator

The American alligator (*Alligator mississippiensis)* is a large, carnivorous reptile related to crocodiles that inhabits freshwater lakes, ponds, marshes, sloughs, swamps, canals and, occasionally, brackish waters throughout the southeastern United States. It is commonly seen on canal banks throughout the EAA and in the WCAs.

In 1985, alligators were down-listed in Florida from "threatened" to status of "threatened due to similarity of appearance" because of its similarity to the endangered American crocodile (*Crocodylus acutus*). A distinguishing characteristic from the American crocodile, a close relative, is that only the upper teeth are visible with the alligator's mouth closed, while both the upper and lower teeth are visible on the American crocodile. The listing "threatened due to similarity of appearance" is defined for species that are not currently biologically threatened but that are believed likely to become endangered in the future (50 CFR Part 17). Therefore, no coordination is needed for this species.

3.8.2.5.2 Eastern Indigo Snake

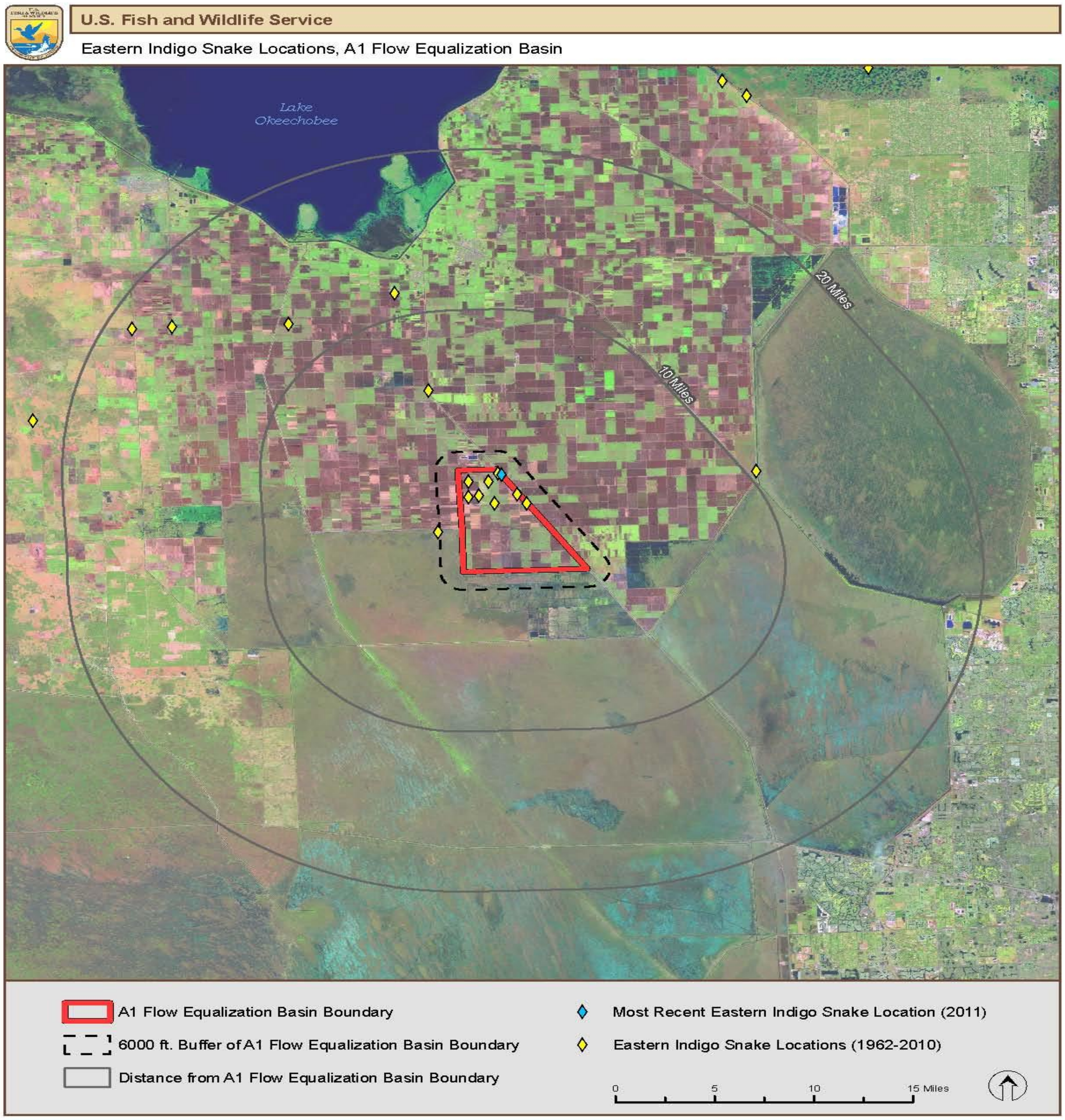
The eastern indigo snake (*Drymarchon corais couperi*) is federally listed as threatened. It is a large, black, non-venomous snake that reaches lengths up to of 265 cm (Ashton and Ashton 1981). Its historical range extended throughout Florida and the coastal plains of Mississippi, Alabama, and Georgia (USFWS 1999).

The eastern indigo snakes preferred habitats are uplands (flatwoods, dry prairies, tropical hardwood hammocks, and coastal dunes). They are not usually found in Everglades wetlands (Steiner and others 1983), but can be found on the edges of freshwater marshes and in agricultural fields (USFWS 1999). They are extremely susceptible to desiccation and cold. In dry, cold habitats (Georgia, Alabama, and the Florida panhandle), eastern indigo snakes depend on the holes of the gopher tortoise (*Gopherus polyphemus*), which provide protection from cold and dry conditions (Layne and Steiner 1996). Throughout the warmer environment of peninsular Florida, eastern indigo snakes may exist in any terrestrial habitats with low urban development (USFWS 1999). They frequently use natural holes, gopher tortoise burrows, trash piles and the like even in warmer south Florida. They use a variety of food sources including fish, frogs, toads, lizards, turtles and their eggs, small alligators, birds and small mammals (USFWS, 1999).

Initially, the population decline of eastern indigo snakes was from over-collecting for the pet trade (43 FR 4028), but current major threats to the eastern indigo snake include loss and fragmentation of habitat from increased development (USFWS 1999). Other threats to the eastern indigo snake associated with development include increased mortality from vehicular collisions, domestic pets, and people, and pesticides (USFWS 1999).

Eastern indigo snakes range over large areas and use various habitats throughout the year, with most activity occurring in the summer and fall (Smith 1987; Moler 1985a). Adult males have larger home ranges than adult females and juveniles; their ranges average 554 acres (Moler 1985b). In contrast, a gravid female may use from 3.5 to 106 acres (Smith 1987). In Florida, home ranges for females and males range from 5 to 371 acres and 4 to 805 acres, respectively (Smith 2003). At the Archbold Biological Station (ABS), average home range size for females was determined to be 47 acre and overlapping male home ranges to be 185 acre (Layne and Steiner 1996).

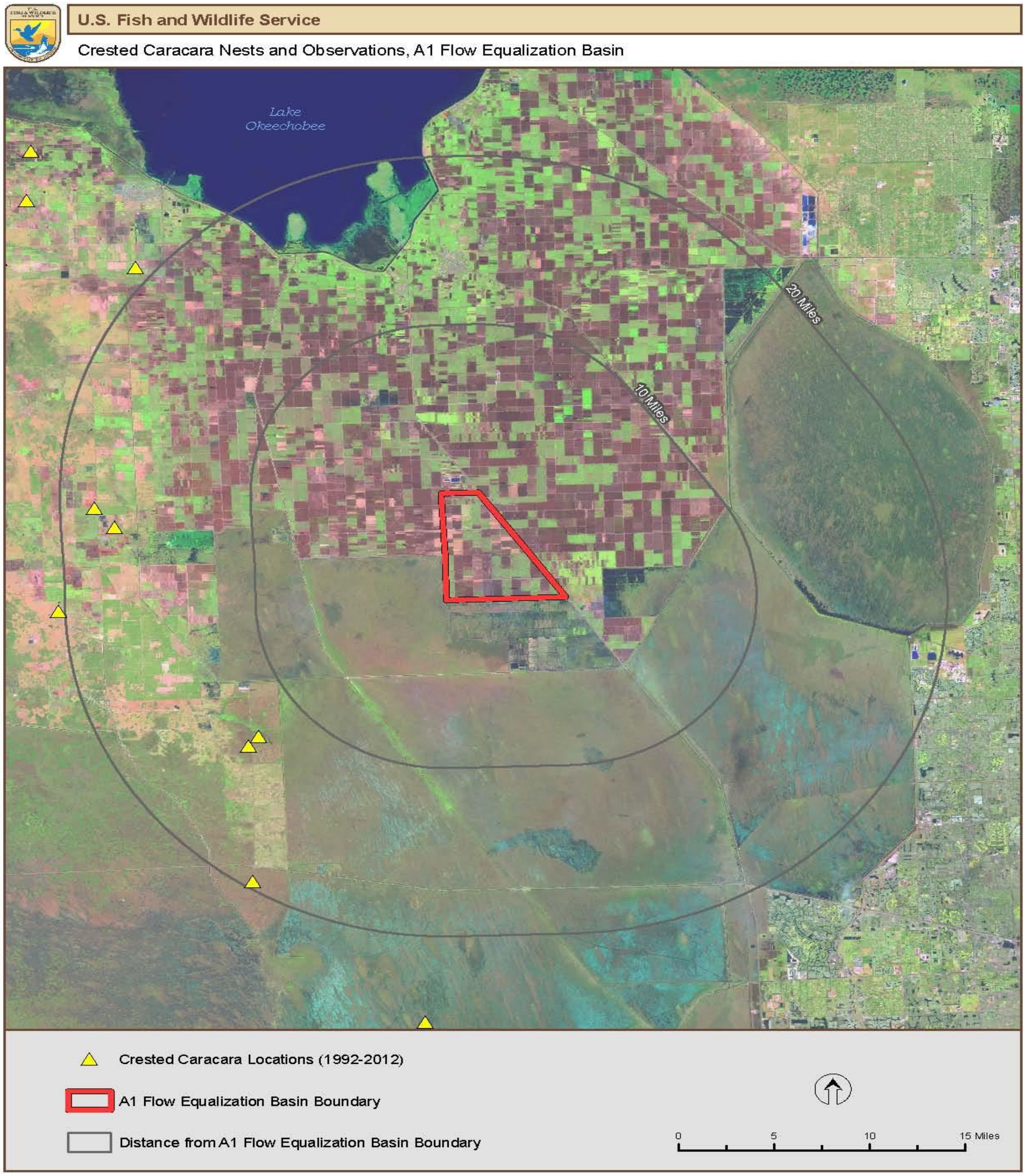
Figure 3-18 Eastern Indigo Snake Sightings



3.8.2.5.3 Audubon's Crested Caracara

The Audubon's crested caracara (*Polyborus plancus audubonii*) is federally listed as threatened. It is a large non-migratory raptor with its overall distribution including the southern United States, Mexico, and Central America to Panama. In Florida, the most abundant populations of crested caracara are in Glades, Desoto, Highlands, Okeechobee, and Osceola counties, all of which are located north and west of Lake Okeechobee (USFWS 1999). Caracaras are most commonly found in dry or wet prairies with occasional cabbage palms (*Sabal palmetto*) or scattered wooded vegetation. Prey include insects and other small invertebrates, small mammals, reptiles, and fish. Because of changes in land use, the crested caracara also now uses improved or semi-improved pastures (USFWS 1999). The primary threat to the crested caracara is in the conversion from dried prairies to agriculture and development. The project site is located within a USFWS crested caracara consultation area. See **Figure 3-19** for the nearest documented occurrence of the Audubon's crested caracara in relation to the project site.

Figure 3-19 Audubon's Crested Caracara Locations



3.8.2.5.4 Everglade Snail Kite

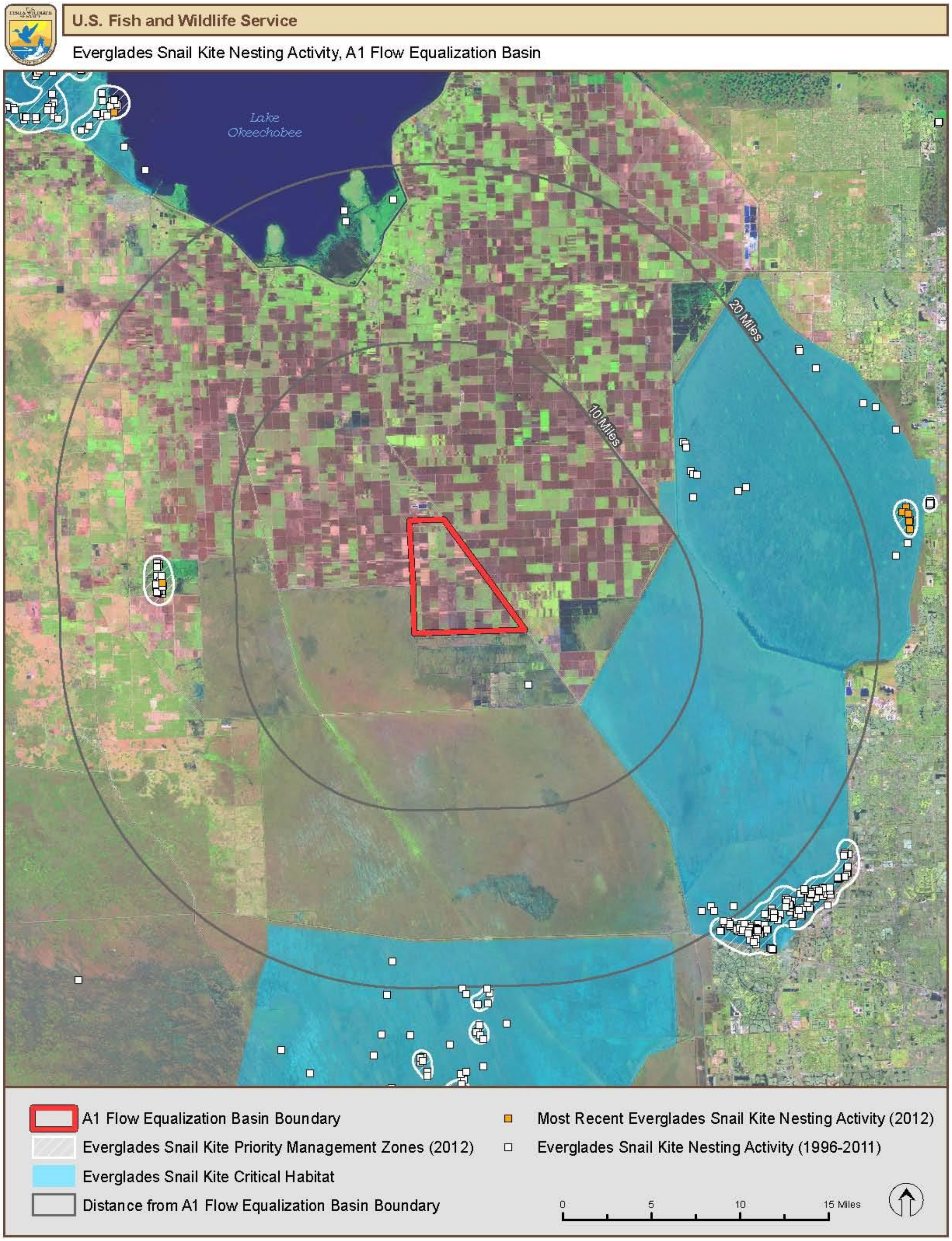
The endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is a medium sized raptor that feeds almost entirely on apple snails (*Pomacea paludosa*) which are found in palustrine emergent, long hydroperiod wetlands (USFWS, 1999). The snail kite's foraging habitat is restricted to clear, calm waters of freshwater marshes and shallow vegetated littoral zones of lakes in South and Central Florida including Palm Beach and Hendry Counties. Snail kites require small trees or shrubs near foraging areas as nest sites and shallow inundated areas to sustain their food source, apple snail.

Apple snails inhabit a wide range of ecosystems from swamps, ditches and ponds to lakes and rivers. Apple snails eat, feed, breed, and lay eggs on emergent vegetation in waterbodies that are flooded continuously for longer than 1 year (USFWS 1999). Changes in water regimes and depth and duration of inundation are important characteristics for wetland vegetation that supports snail kite nesting and foraging habitat, Florida apple snails, and all aspects of snail kite and apple snail life history. Rapid and/or large increases in water depth may detrimentally affect desirable vegetation, and can flood out Florida apple snail eggs, leading to reductions in apple snail populations and reduced snail kite foraging (USFWS 2006).

Designated critical habitat for the snail kite exists on the western side of Lake Okeechobee and portions of the EPA, including WCA 1, WCA 2 and WCA 3A. Snail kites are also found in Holey Land. Wood storks and snail kites have overlapping ranges, but different feeding mechanisms and require different hydrologic conditions for optimum feeding. Historically, both have survived with the hydrologic variability characteristic of the natural system. The reduced heterogeneity and extent of natural area of the present system make the snail kites more vulnerable to natural and human-caused threats (USFWS, 1999).

Loss and degradation of habitat are the primary threat to snail kites. Water levels, duration, and quality are primary concerns in Everglade snail kite conservation. Water levels must allow for appropriate nesting sites, durations of water levels must be sufficient to support apple snail populations, and water quality must be such that invasive species do not take over Everglade snail kite foraging habitat (USFWS 1999). The project site, the STAs and WCAs are all within Everglade snail kite USFWS consultation area. The nearest nest to the project area, recorded in 2011, was located approximately 3 miles from the A-1 project site (**Figure 3-20**). The most recent nests, recorded in 2012, were located 14.1 miles to the west and 22.3 miles to the east (WCA 1).

Figure 3-20 Everglades Snail Kite Nesting Activity

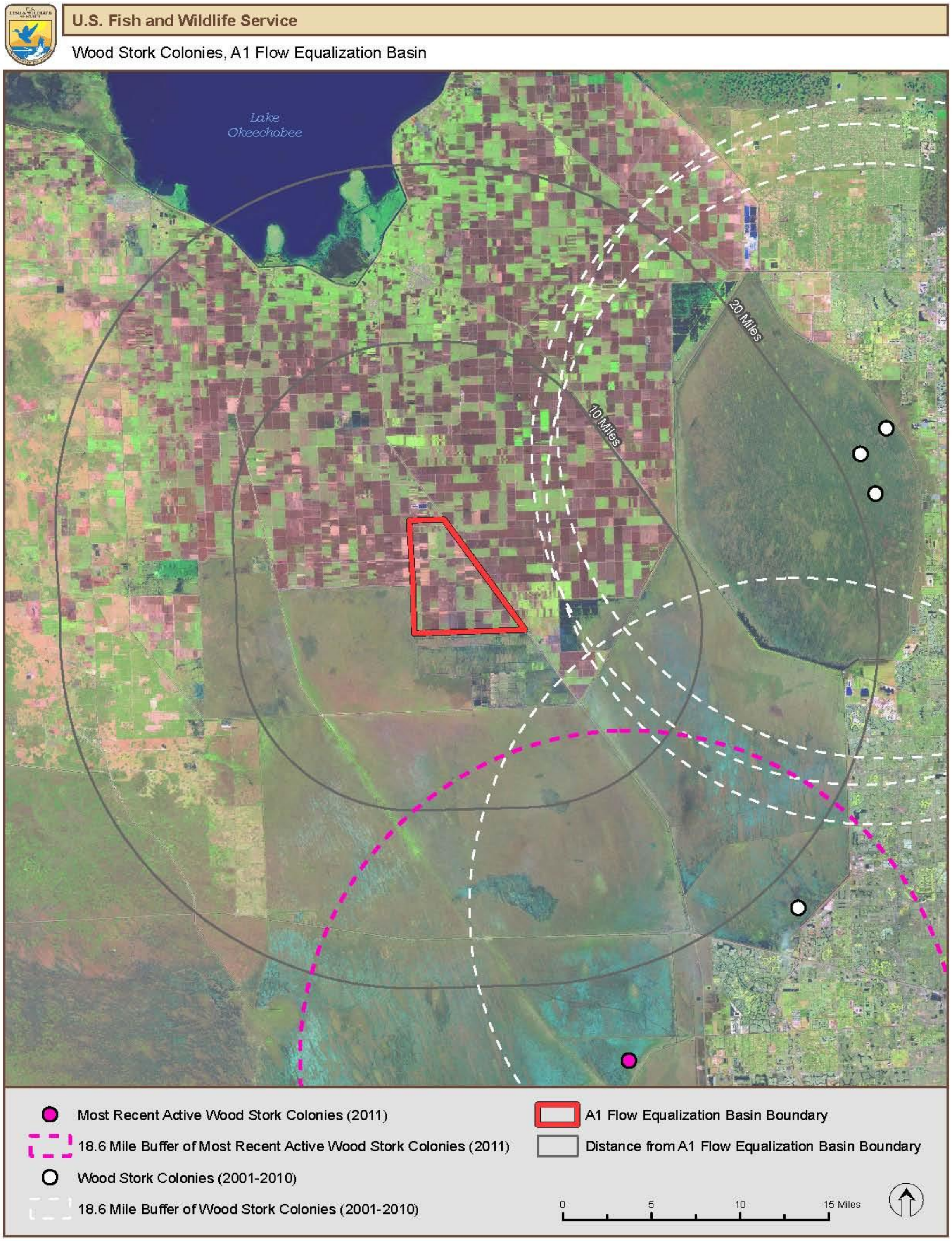


3.8.2.5.5 Wood Stork

The endangered wood storks (*Mycteria Americana*) are tall, long-legged wading birds that utilize a variety of freshwater and estuarine wetlands (USFWS 1999) including shallow freshwater wetlands, canals, and ditches to catch prey. Historically, breeding colonies existed in coastal states from Texas to South Carolina, but today breeding colonies are limited to Georgia, Florida, and coastal South Carolina (USFWS 1999). Their non-breeding season range extends throughout the continental United States.

The timing, duration, and quantity of water affect wood stork distribution for two reasons: shallow waters with high prey densities are needed for feeding; and they prefer nesting sites surrounded by deep water. The primary prey of wood storks is small fish. During feeding, wood storks immerse their bill, partly open, in water and snap it shut when it contacts a prey item (Kahl 1964, as cited in USFWS 1999). This feeding behavior, known as tactolocation or grope feeding, requires high prey concentrations found after drying events that concentrate fish to smaller areas. Nesting colonies of wood storks are usually established in stands of medium to tall trees, such as cypress stands or mangrove forests, surrounded by deeper water marshes (Palmer 1962; Rogers and others 1996; and Ogden 1991, as cited in USFWS 1999). These areas provide protection from terrestrial predators. Core foraging areas include an 18.6-mile radius around breeding colonies (USFWS SLOPES). The nearest active colony reported in 2009 is located 21.2 miles from the A-1 project site (**Figure 3-21**). Documented in 2011, the most recent active colony is 25.0 miles south of A-1 project site (USFWS GIS database, 2012).

Figure 3-21 Wood Stork Colonies



3.8.2.5.6 Florida Panther

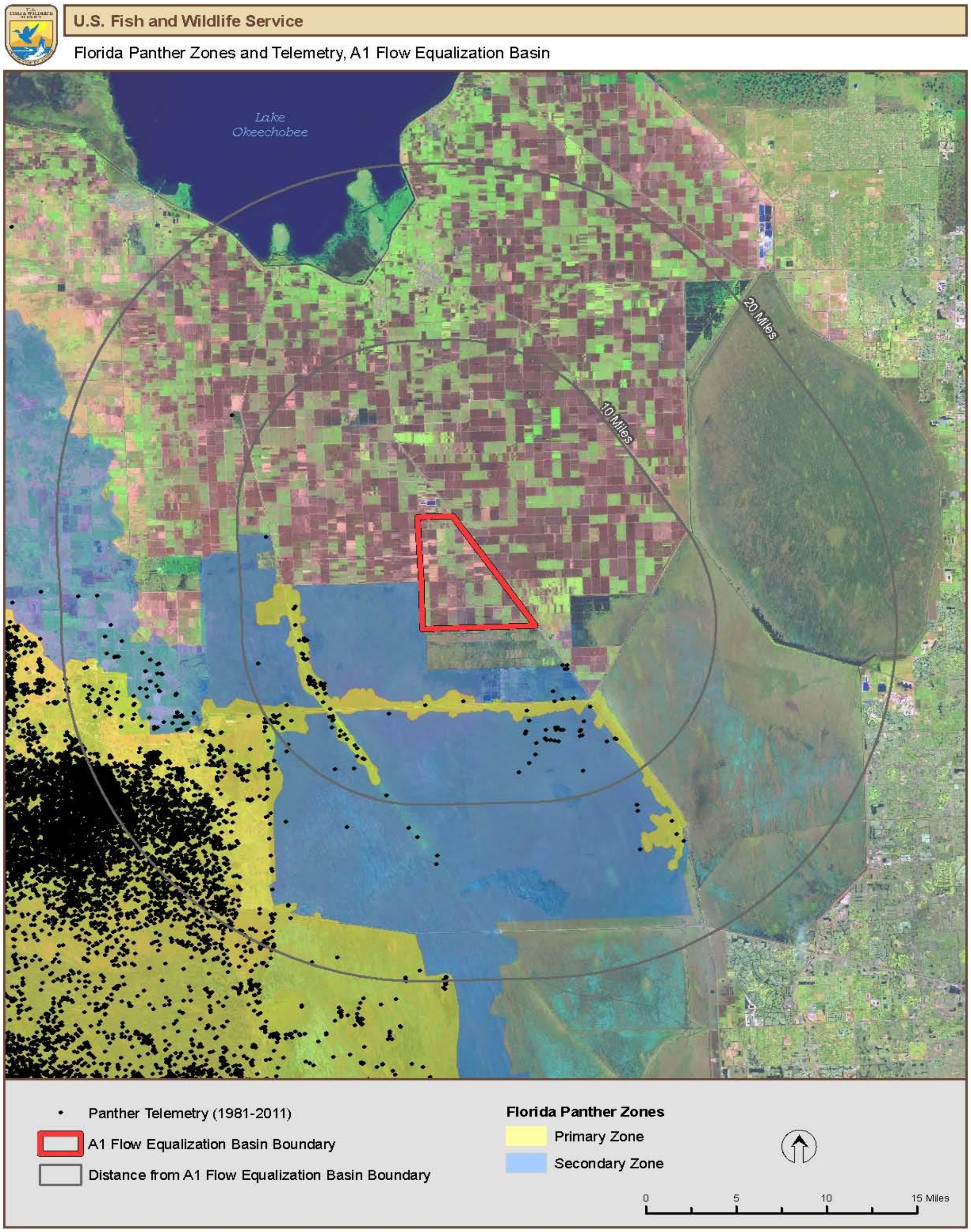
The Florida panther (*Puma concolor coryi*), a medium-sized tawny-colored long-tailed puma, is one of the most federally listed endangered land mammal. At one time, the panther's range extended through Arkansas, Louisiana, Mississippi, Alabama, Georgia, Southern Tennessee, South Carolina, and Florida. Today, the only existing population is found in a two million acre area in central and South Florida with population estimates of only 80 total individuals, 30 to 50 adults and approximately 30 subadults (USFWS 1999). The Big Cypress Swamps/Everglades has the only known breeding panther population (USFWS 1999).

The Florida panther, a subspecies of the mountain lion, is Florida's designated state mammal. Male panthers weigh 102 to 154 pounds and reach 7 feet in length, while the smaller females weigh 50 to 108 pounds and reach 6 feet in length (Roelke 1990). Panther's preferred habitats are hardwood hammocks and pine flatwoods, but they can also be found in wetlands and disturbed habitat (USFWS 1999). The panther diet includes feral hogs (*Sus scrofa*), white-tailed deer *(Odocoileus virginianus)*, raccoon (*Procyon lotor*), and armadillo (*Dasypus novemcinctus*) (Maehr *et. al.* 1990).

Habitat loss and fragmentation from development are the largest threat to panthers and have lead to inbreeding, reduced prey availability, and mortality from vehicle strikes. An individual panther range may extend on average 200 square miles for males and 74 square miles for females (Land 1994). The panther's wide-range recovery plan cites three conditions necessary for the survival and recovery of the species: (1) protection and enhancement of existing populations, habitats, and prey resources; (2) improving genetic health and population viability; and (3) re-establishing a minimum of two more reproducing populations within the historical range.

Panther telemetry data from 1981 to 2005 show panthers in the EAA, including areas directly adjacent to the project site and in WCA 3A (USFWS 2006). Based on the USFWS' GIS Database, **Figure 3-22** depicts the panther telemetry data from 1997 through 2011.

Figure 3-22 Panther Telemetry



3.8.3 STATE LISTED SPECIES

3.8.3.1 Project Site

The project site and the affected areas contain habitat for several state listed species. The scraped wetlands on the project site contain habitat for several State-listed birds, such as the Florida sandhill crane, limpkin, snowy egret, little blue heron, tricolored heron, white ibis, and roseate spoonbill. SFWMD staff has conducted wildlife surveys on the project site in December 2012 and February 2013. Multiple species of wading birds, including tricolored herons, little blue herons, great egrets, white ibises, snowy egrets, wood storks, and roseate spoonbills have been observed foraging at the site while limpkins have been heard calling. Black-necked stilt, Everglade's snail kite, Audubon's crested caracara, eastern indigo snake, Florida panther, burrowing owl, or least tern were not observed within the A-1 project site during the surveys. However, least terns have been observed nesting within the project site during previous years. In addition, the Florida burrowing owl and the least tern are known to nest near the project site.

3.8.3.2 Overall Area

State listed endangered animal species include the whooping crane (*Grus Americana*) while the listed threatened animal species include the Florida sandhill crane (*Grus Canadensis pratensis*) and the least tern (*Sternula antillarum*). The species of special concern include the Florida mouse (*Podomys floridanus*), black skimmer (*Rynchopsniger*), limpkin (*Aramus guarauna*), reddish egret (*Egretta rufescens*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), white ibis (*Eudocimus albus*), roseate spoonbill (*Ajaia ajaia*), the burrowing owl (*Athene cunicularia*), gopher tortoise (*Gopherus polyphemus*), and the gopher frog (*Rana capito*). Information for each species was obtained directly from the Florida Fish and Wildlife Conservation Commission's website at:

http://myfwc.com/wildlifehabitats/imperiled/profiles.

3.8.3.3 Endangered Species

3.8.3.3.1 Whooping Crane

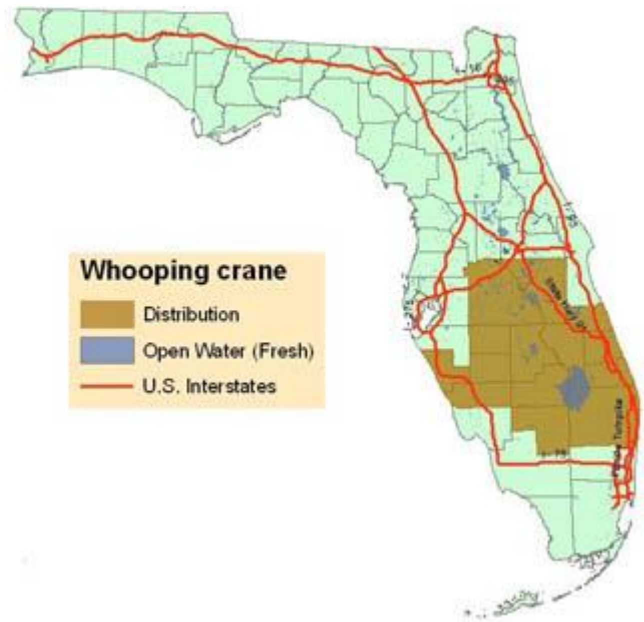
The whooping crane is the tallest bird in North America, standing nearly five feet tall with a wing span of seven to eight feet. Adult whooping cranes are solid white with a red crown on their head, long black legs, and a long "S" shaped neck. Whooping crane chicks have a cinnamon brown body color; however, by the age of four months they will begin to gain adult-like white feathers. The diet of whooping cranes primarily consists of aquatic invertebrates (insects, crustaceans, and mollusks), small vertebrates (fish, reptiles, amphibians, birds, and mammals), roots, acorns, and berries.

While courting, males will perform a dancing ritual that includes them jumping, flapping their wings, and tossing objects into the air (The Cornell Lab of Ornithology 2011). The nesting season in Wood Buffalo National Park (located in Alberta and the Northwest Territories of Canada) occurs between the months of April and May, while cranes in Florida breed between the months of January and May. The clutch size for the whooping crane ranges from one to three eggs (M. Folk pers comm. 2011). Eggs are incubated for 29-31 days with both parents sharing the incubating duties. Breeding pairs will re-nest if the first clutch of eggs is destroyed before mid-incubation. It is rare for more than one of the chicks from a single nest to survive. Whooping crane chicks are able to fly (fledge) at 80 to 90 days old. Juvenile migratory cranes become independent from their parents on their first migration north, while non-migratory whooping cranes become independent before their parents' next breeding season. Whooping cranes mate for life, but will pick new partners if the previous partner is lost. Females produce their first fertile eggs at four to seven years of age.

Habitat and Distribution

Whooping cranes have a very limited range and only inhabit shallow marshes and open grasslands (**Figure 3-23**). The only natural whooping crane nesting population is located in Wood Buffalo National Park. This population winters in and around Aransas National Wildlife Refuge, which is located on the Texas Gulf Coast. There is a non-migratory population in Central Florida that the Fish and Wildlife Conservation Commission introduced in 1993. The introduction was stopped in 2008 due to survival and reproduction problems. During the winter, migratory whooping cranes are led by an ultra-light aircraft from Wisconsin to Florida. A new project to reintroduce non-migratory whooping cranes to Louisiana was begun in early 2011 (Louisiana Department of Wildlife and Fisheries 2011).

Figure 3-23 Whooping Crane Distribution



Threats

The main threat to the whooping crane is the alteration and degradation of their habitat in the Aransas National Wildlife Refuge. Pollution is also a threat to the whooping crane in Aransas, as the boats and barges in the Intracoastal Waterway carry toxic chemicals that could cause devastating effects to the species if spilled. Their extremely small range also puts them at risk to suffer a population decline during natural disaster events. Other threats include illegal hunting, collisions with cars, and increased predation by other species such as the black bear, wolverine, gray wolf, red fox, lynx, and bald eagle (Lewis 1995). Also, in recent times, wind farms and their associated power lines in the migratory corridor have become a major concern (Canadian Wildlife Service and U.S. Fish & Wildlife Service 2007).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/whooping-crane/

3.8.3.4 Threatened Species

3.8.3.4.1 Florida Sandhill Crane

The Florida sandhill crane can reach a height of 47.2 inches (120 centimeters) with a wingspan around 78.7 inches (200 centimeters) (Nesbitt 1996). This species is gray with a long neck and legs, and a bald spot of red skin on the top of its head. The sandhill crane is unique in flight as it can be seen flying with its neck stretched out completely.

Life History

The diet of the Florida sandhill crane primarily consists of grain, berries, seeds, insects, worms, mice, small birds, snakes, lizards, and frogs. Florida sandhill cranes are a non-migratory species that nests in freshwater ponds and marshes. This species is monogamous (breeds with one mate). Courtship consists of dancing, which features jumping, running, and wing flapping (International Crane Foundation, n.d.). Sandhill crane nests are built by both mates with grass, moss, and sticks. Females lay two eggs that incubate for 32 days. Both male and female participate in incubating the eggs (Nesbitt 1996). The offspring will begin traveling from the nest with their parents just 24-hours after hatching. At ten months old, juveniles are able to leave their parents (Nesbitt 1996). Bonding between pairs begins at two years old.

Habitat and Distribution

Florida sandhill cranes inhabit freshwater marshes, prairies, and pastures (Florida Natural Areas Inventory 2001). They occur throughout peninsular Florida north to the Okefenokee Swamp in southern Georgia; however, they are less common at the northernmost and southernmost portions of this range (**Figure 3-24**). Florida's Kissimmee and Desoto prairie regions are home to the state's most abundant populations (Meine and Archibald 1996).

Figure 3-24 Florida Sandhill Crane Distribution

Threats

Degradation or direct loss of habitat due to wetland drainage or conversion of prairie for development or agricultural use is the primary threats facing Florida sandhill cranes. The range of the Florida sandhill crane diminished in the southeastern United States during the 20th century, with breeding populations disappearing from coastal Texas, Alabama, and southern Louisiana due to degradation, habitat loss, and overhunting. (Meine and Archibald 1996).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/florida-sandhill-crane/

3.8.3.4.2 Least tern

The least tern is the smallest tern in North America. Least terns can reach a length between 8.3-9.1 inches (21-23 centimeters) with a wingspan of 21-23 inches (53-58 centimeters) (Thompson et al., 1997). Least terns have long pointed wings and a deeply forked tail. Other physical characteristics include a yellow beak, gray back, white belly, and black cap.

Life History

The least tern's diet primarily consists of fish, but they will also feed on small invertebrates. (The Cornell Lab of Ornithology, 2011). Male least terns have a unique courtship ritual. During courting, the male will offer the female food in hopes of gaining her choice as a mate. Once the two mates are together they will begin building the nest in shallow depressions in bare beach sand. Least terns will also build nests on gravel rooftops. Least terns lay eggs between the middle of April and the beginning of May. The eggs are camouflaged to help prevent predation. Egg incubation lasts for 21 days. Young least terns are able to leave the nest three to four days after hatching.

Habitat and Distribution

The least tern inhabits areas along the coasts of Florida including estuaries and bays, as well as areas around rivers in the Great Plains (Florida Natural Areas Inventory 2001). In Florida, the least tern can be found throughout most coastal areas (**Figure 3-25**). Outside of Florida, least terns are found along the U.S. Atlantic Coast, mid Atlantic states, and down from Mexico to northern Argentina (Florida Natural Areas Inventory 2001)

Figure 3-25 Least Tern Distribution

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Threats

The least tern faces many threats as the human population increases along the coasts. The main threat to the least tern population is habitat loss. Loss of habitat is often attributed to coastal development. Coastal development causes damage to least tern habitat because of the building on the coasts, human traffic on the beaches, and recreational activities. Increased numbers of predators due to the larger amounts of available food and trash for scavenging are also a threat to the least tern. Predators can cause destruction to breeding colonies while they are nesting by destroying nests and eating chicks and eggs. Also, global climate change is an impending threat to the least tern. Rising sea levels and more frequent strong storms may damage and destroy least tern nests, as well as habitat. Spring tides can also cause flooding of least tern nests. Other threats to the least tern include shoreline hardening, mechanical raking, oil spills, response to oil spill events, and increased presence of domestic animals (Defeo et al. 2009).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/least-tern/

3.8.3.5 Species of Special Concern

3.8.3.5.1 Florida mouse

The Florida mouse is a large member of the genus *Podomys* that can reach a length of eight inches (20.3 centimeters) and a weight of 0.7 to 1.7 ounces (36.9-49 grams). This species has a yellowish-brown upper body with orange colored sides and a white belly. It also has five plantar tubercles (foot pads) on each foot, which is distinct to the species (Florida Natural Areas Inventory 2001, Layne 1990, Layne 1992, Jones and Layne 1993).

Life History

The diet of the Florida mouse primarily consists of seeds, plants, fungi, and insects (Smithsonian National Museum of Natural History, n.d.).The Florida mouse digs small burrows inside the burrows of other species, primarily the gopher tortoise, where they will prepare a nest (Smithsonian National Museum of Natural History, n.d.). Reproduction occurs throughout the year, but peaks in the fall and winter. The number of young per litter is typically between two and four. Offspring are weaned at three to four weeks of age (Jones 1990, Layne 1990, Jones and Lane 1993).

Habitat and Distribution

The Florida mouse inhabits xeric uplands (ecological communities with well drained soils) such as sandhill and scrub (Florida Natural Areas Inventory 2001). Peripheral peninsular counties are St. Johns, Clay, Putnam, Alachua, Suwannee, and Taylor counties in the north, south to Sarasota County on the west coast (although not documented in Sarasota County in recent years), south to Highlands County in central Florida, and, at least formerly, south to Dade County on the east coast now south to near Boynton Beach (**Figure 3-26**) (Layne 1992; Jones and Layne 1993; Pergams et al. 2008).

Figure 3-26 Florida Mouse Distribution

Threats

The Florida mouse exhibits narrow preferences for fire-maintained, xeric upland habitats occurring on deep, well-drained soils, especially scrub and sandhill habitats (Jones and Layne 1993). Because of this narrow habitat specificity, the major threat to the Florida mouse is loss and degradation of habitat caused by conversion to other uses (e.g. development and agricultural use) and insufficient management (e.g., fire suppression) (Layne 1990, 1992). In Highlands County, 64% of the species' habitat was destroyed between 1940 and 1980, with an additional 10% considered disturbed or degraded (Layne 1992).

http://myfwc.com/wildlifehabitats/imperiled/profiles/mammals/florida-mouse/

3.8.3.5.2 Black skimmer

The black skimmer is a seabird with defining physical characteristics that make it easily distinguishable from others. The key physical feature of the skimmer is its large red and black bill. The bill begins to widen at the top and gradually becomes smaller as it forms a sharp tip at the end of the bill. The lower part of the bill is longer than the top, which is important because they use their bill to skim along the top of the water to catch fish, for which they are aptly named. Skimmers can reach a height of 19.7 inches (50 centimeters) with a wingspan of 3 to

3.5 feet (.9-1.1 meters) (The Cornell Lab of Ornithology 2011, E. Sachs pers. comm. 2011). Skimmers have a black back, black wings with white edging, and a white belly and head.

Life History

The diet of the black skimmer primarily consists of fish. The skimmer has a unique style of feeding that involves literally "skimming" the surface of the water with their lower bill. When they contact a prey item, they quickly bend their head forward and snap the upper bill closed, seizing their prey. Breeding occurs during the summer, generally between May and early September (Katja Schulz, n.d.). Skimmers nest on the sand along beaches, sandbars, and islands developed by dredged-up material. Nesting occurs in colonies consisting of one to several hundred pairs of skimmers. Skimmers are protective of their nests and offspring and will utilize group mobbing to protect the nests. Skimmers usually lay three to five eggs per nest and eggs are incubated by both parents for approximately 23-25 days (The Cornell Lab of Ornithology 2011). Each parent incubates the eggs for up to four hours at a time (Gochfield and Burger, 1994). Once hatched, parents guard the offspring until they are able to fly at about 28-30 days old (Katja Schulz, n.d.).

Habitat and Distribution

The black skimmer inhabits coastal areas in Florida such as estuaries, beaches, and sandbars (**Figure 3-27**). Skimmers can be found from the coasts of the northeastern U.S., down to Mexico, and over to the Gulf Coast of Florida. Breeding range is from Southern California, down to Ecuador.

Figure 3-27 Black Skimmer Distribution

Threats:

The black skimmer faces many threats as the human population increases and spreads to previously undeveloped coasts. Habitat loss due to coastal development is the main threat to the species. People are relocating to the coasts at unprecedented levels causing increased development and traffic on the beaches, as well as increased predators; all of which are detrimental to skimmer habitat. Predators will feed on skimmer eggs and chicks and include species such as raccoons, crows, opossums, feral hogs, and coyotes. Because skimmers nest on the beach and are colonial they are extremely vulnerable to disturbance by people, pets, and predators. Other threats include recreational activity, beach driving, shoreline hardening, mechanical raking, oil spills, and increased presence of domestic animals, all of which may prevent or disrupt nesting or result in the death or abandonment of eggs and young. Global climate change is an impending threat to the black skimmer. Sea level rise may cause destruction to primary nesting areas, resulting in a decreased population size.

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/black-skimmer/

3.8.3.5.3 Limpkin

The limpkin is a long-legged species of waterbird that has dark brown feathers with streaks of white on the head and neck and absent on the rest of the body. Limpkins can grow up to 28 inches (71.1 centimeters) long, with a 42 inch (106.7 centimeters) wingspan, and weigh up to 46 ounces (1,304 grams) (The Cornell Lab of Ornithology 2011). White blotches and triangular marks can be found on the neck and upper body. The key physical feature of the limpkin is their down-curved bill, which is used to feed on their primary prey, apple snails. Limpkins are also known for their resounding calls, which are characterized as a high pitched "Kree-ow, Kra-ow" sound.

Life History

Limpkins feed primarily on apple snails, but they will also eat insects, worms, and mussels. Limpkins will walk in shallow waters searching for apple snails and utilize their down-curved bills to get the snail out of its shell. The limpkin nests in a variety of areas including vegetation in marshes and freshwater, and in bushes or tree limbs that are up to 40 feet high (12.2 meters) (The Cornell Lab of Ornithology 2011). The limpkin courtship ritual includes the male feeding the female, imitating an adult feeding a juvenile. Nesting occurs between the months of February and June. The female will lay between four to eight eggs in one nesting season and incubate the eggs for approximately 27 days (The Cornell Lab of Ornithology 2011).

Habitat and Distribution

The limpkin inhabits shallows along rivers, streams, lakes, and in marshes, swamps and sloughs in Florida (**Figure 3-28**). In the U.S., the Limpkin is found only in the Florida. Limpkins are fairly widespread in peninsular Florida, but rarer in the Panhandle and Keys. Outside of the U.S., they are found in the Caribbean, Central America, and most of South America east of the Andes Mountains.

Figure 3-28 Limpkin Distribution

Threats

Historically, the limpkin was almost extirpated from Florida due to overhunting. New laws and conservation efforts prevented this from happening and the population recovered. There are still major threats to the limpkin population that include the decline of their primary prey, apple snails. Due to habitat destruction and wetland drainage, heavy accumulations of non-native vegetation (mainly hyacinths and cattails) in foraging areas prevents the limpkin from being able to locate food. Other threats include pollution and an overabundance of nutrition in wetlands (Crozier and Gawlik, 2002; Bryan 2002).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/limpkin/

3.8.3.5.4 White Ibis

The white ibis is easily identified by its long red legs, all white plumage, red face, long decurved red bill and black tipped wings. White ibises are medium-sized wading birds, weighing about two pounds, with a 36-inch wingspan, and a length of 24 inches. White ibises inhabit shallow coastal marshes, wetlands and mangrove swamps and feed on crayfish, crabs, insects, snakes, frogs and fish (Kushlan and Bildstein 1992). Nesting occurs in trees, shrubs, and grass clumps from ground level to a height of 50 feet. Nests are constructed of vegetation sticks, leaves and/or roots. Females typically lay two to three eggs; eggs are incubated for 21 to 22 days. The young are able to leave the nest at 9 to 16 days of age. Nestlings are independent at 40 to 50 days of age. Breeding season extends from March to August (FWC 2003c). Ibises are known for frequent shifts in roost and colony sites.

The white ibis has been recorded breeding throughout the state of Florida; the center of breeding abundance occurs in the Everglades, with breeding populations extending into Florida Bay and the Keys (FWC 2003c). Aerial surveys have revealed 90 percent declines in south Florida breeding pairs since the 1940s and 20 to 50 percent declines statewide during the past decade. Because of this, the FWC listed the white ibis as a state listed species of special concern (FWC 2003c). Population declines of the species are attributed to loss and degradation of suitable habitat; however, large populations of white ibises remain.

The white ibis is a midsized member of the Family Threskiornithidae. This species is approximately 22 inches (56 centimeters) long with a wingspan of approximately 37 inches (96 centimeters) (Frederick 1996). Adults are mostly white with black tipped wings, a red face, red legs, and a very distinct downcurved, pink bill which is used to probe the ground for food while foraging.

Life History

The diet of the white ibis primarily consists of crabs, crayfish, fish, snakes, frogs, and insects. Ibis breed in large colonial groups along the coast and inland between February and October, with the peak in the spring and summer. Nests are made of sticks, leaves, and roots, and can be found both on the ground and as high as 50 feet (15.2 meters) up in trees. Females lay between two and four eggs in one nesting and incubation can last up to 22 days with both parents sharing incubation responsibility. Between the ages of 9 and 16 days, the young become more mobile; however, the young generally remain in the nest until they are 28 to 35 days old.

Habitat and Distribution

White ibis prefer coastal marshes and wetlands, feeding in fresh, brackish, and saltwater environments. They range from Baja California and Sinaloa, Mexico, east through south Texas, Louisiana, Alabama, Georgia, coastal North Carolina, south throughout the Greater Antilles, and South America to Peru, and French Guiana. This species is found throughout most of Florida (Figure 3-29).

Figure 3-29 White Ibis Distribution

Threats

The main threat to the white ibis is the loss of wetland habitat due to the human development of coastal areas and their freshwater feeding areas. The alteration of wetlands, pollution, and saltwater influxes are other habitat threats as these practices degrade the quality of wetlands and decrease the availability of prey (Florida Natural Areas Inventory 2001, Bildstein et al. 1990, Frederick 1987, Adams and Frederick 2009, Herring et al. 2010).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/white-ibis/

3.8.3.5.5 Snowy Egret, Reddish Egret, Little Blue Heron and Tricolored Heron

The snowy egret, reddish egret, little blue heron and tricolored heron are listed by the FWC as a species of special concern. Snowy egrets are medium sized herons, with entirely white plumage, long slender black bills, long black legs and bright yellow feet (Parsons and Masters 2000). The snowy egret breeds in Florida from January through August, breeding mostly in central and southern Florida in freshwater and saltwater marshes (FWC 2003c). The tricolored heron occupies similar habitats; breeding occurs in February through August (FWC 2003c). The tricolored heron is ornately colored; it is slate-blue on its head and upper body and has a purplish chest with white under parts and fore-neck (Frederick 1997). The little blue heron is a smaller-sized heron, dark overall with yellow-green legs, and a blue bill with a black tip (Rodgers and Smith 1995). The little blue heron shows a preference for freshwater habitat; however, it also inhabits saltwater marshes. Little blue herons breed later than tricolored herons or snowy egrets; breeding occurs in April through September in Florida. The little blue heron is more widely distributed throughout the state in comparison to the tricolored herons or snowy egrets. Like the snowy egret, breeding populations are concentrated in central and southern Florida (FWC 2003c).

Reddish egrets have two color morphs; white and dark. Dark morphs have gray bodies with chestnut heads, blue legs and pink bills with black tips (Lowther and Paul 2002). The reddish egret is the rarest heron in Florida and is entirely restricted to the Florida coast with concentrations in Florida Bay and the Keys; two-thirds of the state's breeding population. The heron forages on shallow flats and sandbars for fish species, including killifish. In Florida Bay, reddish egrets nest from November through May (FWC 2003c). Population declines of the species are attributed to loss and degradation of suitable habitat. Target nest numbers for snowy egrets and tricolored herons combined are 10,000 to 20,000 pairs. Nesting targets for the snowy egret and tricolored heron have not been met in the WCAs and ENP since the implementation of IOP in 2002. Nesting effort (number of nests) of these species from 2002 to 2008 is summarized as follows; 2000-2002: 8,614 pairs, 2001-2003: 8,088 pairs, 2002-2004: 8,079, 2003-2005: 4,085 pairs, 2004-2006: 6,410 pairs, 2005-2007: 4,400 pairs, 2006-2008 3,778 pairs(SFWMD 2009b). However, target numbers have not been met prior to the current operating regime; 1998-2000: 2,788 pairs, 1999-2001 4,270 pairs. Little blue heron censuses from aerial surveys are unreliable due to its dark plumage and tendency to nest in small, isolated colonies (FWC 2003c).

3.8.3.5.6 Roseate Spoonbill

The roseate spoonbill is the only spoonbill endemic (native) to the Western Hemisphere (Bjork and Powell 1996). This species can reach a length of 30-40 inches (76-102 centimeters) with a wingspan of 50-53 inches (127-135 centimeters). It has pink wings and underparts (with some red on the tops of the wings) with a white neck and back, and pinkish legs and feet. While the species looks almost entirely pink in flight, they actually have no feathers at all on their heads. The pink coloration comes from the organisms on which they feed, which are full of caroteniods (organic pigment) (Texas Parks and Wildlife Department, n.d.). As the name implies, the roseate spoonbill also has a large, spoon-shaped bill, which it sweeps back and forth in shallow water to capture prey.

Life History

The specialized bill has sensitive nerve endings which help the birds search for food in shallow water. The diet of the roseate spoonbill primarily consists of crayfish, shrimp, crabs, and small fish. There is no sexual dimorphism (difference in form between individuals of different genders in the same species) in roseate spoonbills. They nest in mixed colonies (near other wading bird species) in mangroves or trees and though most breed on the coast, some nest inland. Nesting habitats include coastal mangroves and dredged-made islands. (Florida Natural Areas Inventory 2001). The female builds the nest while the male retrieves the nesting materials. The female lays up to three whitish-colored eggs and both adults incubate the eggs for up to 24 days (Smithsonian National Zoological Park, n.d.). The young remain in the nest for approximately 35-42 days and are fed by both adults.

Habitat and Distribution

The roseate spoonbill is a resident breeder in South America, generally east of the Andes, and coastal areas of Central America, the Caribbean, and the Gulf of Mexico (Dumas 2000). Mangrove islands and occasionally dredge-spoil islands are the preferred nesting habitat for the species. In Florida, the species is found in Florida Bay, Tampa Bay, and Brevard County (**Figure 3-30**).

Figure 3-30 Roseate Spoonbill Distribution

Threats

One historical threat to the roseate spoonbill was hunting for their feathers, though this practice is now illegal which has allowed the population to rebound. Another threat to the spoonbill is the availability of adequate food sources and habitat degradation. In the Florida Bay, the increased fresh water flow from the Everglades may affect prey availability for the spoonbill. Other threats include habitat loss and disturbance, pesticides, and illegal shootings (Dumas 2000).

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/roseate-spoonbill/

3.8.3.5.7 Gopher tortoise

The gopher tortoise is a moderate-sized, terrestrial turtle that averages 9-11 inches (23-28 centimeters) long. This species of tortoise has a brown, gray, or tan upper shell (carapace), a yellow lower shell (plastron), and brown to dark gray skin (Florida Natural Areas Inventory 2001). Gopher tortoises have stumpy, elephant-like hind feet and flattened, shovel-like forelimbs that are used for digging burrows.

Life History

Gopher tortoises dig deep burrows that average 15 feet long (4.6 meters) and 6.5 feet (two meters) deep. These burrows provide protection from extreme temperatures, moisture loss, predators, and serve as refuges for 350-400 other species. Because so many other animals depend on the burrows (commensals), gopher tortoises are referred to as a keystone species. Gopher tortoises generally forage within 160 feet (48.8 meters) of their burrows but have been known to travel greater distances to meet their nutritional needs. Gopher tortoises feed on a wide variety of plants including broadleaf grasses, wiregrass, grass-like asters, legumes, blackberries, and the prickly pear cactus.

Gopher tortoises are slow to reach sexual maturity, have low reproductive potential, but they have a long life span – 60 years or longer. Females reach sexual maturity between 10-20 years of age. The breeding season is generally between March and October. Females lay five to nine eggs between May and June. Nests are excavated in areas of abundant sunlight, especially in the sand mound that is located in front of a burrow. Egg incubation lasts 80 to 90 days in Florida. Hatchlings are capable of digging their own burrow, but may use other tortoises' burrows instead (Gopher Tortoise Council 2000).

Habitat and Distribution

Gopher tortoises are found in the southeastern Coastal Plain, from southern South Carolina, southwest to extreme southeastern Louisiana (Florida Natural Areas Inventory 2001). In Florida, tortoises occur in parts of all 67 counties, but prefer high, dry sandy habitats such as longleaf pine-xeric oak sandhills (Figure 3-31). They also may be found in scrub, dry hammocks, pine flatwoods, dry prairies, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of disturbed habitats, such as pastures.

Figure 3-31 Gopher Tortoise Distribution

Threats

The primary threat to the gopher tortoise is habitat loss. Habitat alteration, such as urbanization, generally occurs in the same high, dry habitats that the tortoise prefers. Lack of appropriate land management (especially controlled burning) has also contributed to population declines in areas where natural habitat remains. Other threats include road mortality from vehicles and illegal human predation.

http://myfwc.com/wildlifehabitats/imperiled/profiles/reptiles/gopher-tortoise/

3.8.3.5.8 Gopher frog

The gopher frog is a stout-bodied frog that reaches a length of two to four inches (5.1-10.2 centimeters). This species has a cream to brown-colored body with irregular dark spots on its sides and back, a large head, warty skin, rounded snout, short legs, and a light brown ridge found behind its eyes (Florida Natural Areas Inventory 2001).

Life History

The diet of the gopher frog primarily consists of invertebrates and anurans (frogs and toads) (Godley 1992). The breeding season differs by geographical location, as the North Florida population breeds from February to June and the Central and South Florida population during the summer. Gopher frogs will travel long distances (up to a mile or more) to breed in temporary breeding ponds. Females lay eggs in shallow water in a single mass that can contain 3,000 to 7,000 eggs, which attach to vegetation when released. Once hatched, the tadpoles metamorphose in three to seven months. Gopher frogs usually reach sexual maturity at two years of age (Godley 1992, Palis 1998).

The call of a gopher frog is a deep guttural snore (the sound is developed in the back of the mouth) and heavy rains at any season may stimulate choruses, with many of them calling at once. Sometimes they call from underwater, so as not to attract predators, creating a noise that is detected only by a hydrophone.

Habitat and Distribution

The gopher frog inhabits longleaf pine, xeric oak, and sandhills mostly, but also occurs in upland pine forest, scrub, xeric hammock, mesic and scrubby flatwoods, dry prairie, mixed hardwood-pine communities, and a variety of disturbed habitats (Enge 1997). This species inhabits gopher tortoise burrows, which is how its name originated. Gopher frogs can be found throughout Florida (Map Data from: FNAI, museums, and gopher frog literature) (**Figure 3-32**).

Figure 3-32 Gopher Frog Distribution

Threats

The main threat to the gopher frog is the destruction of its habitat, especially breeding ponds. Exclusion and suppression of fire from wetlands often leads to degradation of breeding ponds through shrub encroachment, peat buildup, and increased evapotranspiration (evaporation of surface water and release of water vapor) from plants shortening the hydroperiods (LaClaire 2001). Coverage of grassy emergent vegetation decreases and peat buildup may acidify the water past tolerance levels of the gopher frog (Smith and Braswell 1994). Another threat to gopher frog populations is the introduction of game and predaceous fish into formerly fish-free wetlands during natural flooding events. The introduction of these fish causes increased predation of the gopher frog's eggs and tadpoles. The gopher frog also faces threats of disease, such as contraction of the *Anuraperkinsus* mesomycetozoan (yeast-like) pathogen - an infectious parasite.

http://myfwc.com/wildlifehabitats/imperiled/profiles/amphibians/gopher-frog/

3.8.3.5.9 Burrowing owl

The diet of the burrowing owl primarily consists of insects; however, they will also feed on snakes, frogs, small lizards, birds, and rodents. Nesting season occurs between October and May, with March being the primary time for laying eggs. Nesting occurs in burrows in the ground that they dig. These burrows will be maintained and used again the following year (Haug et al. 1993). Females lay up to eight eggs within a one-week period, and they will incubate the eggs for up to 28 days. Once the white-feathered juveniles are born, it takes two weeks before they are ready and able to appear out of the burrow. Juveniles will begin learning how to fly at four weeks, but will not be able to fly well until they are six weeks old. Juveniles will stay with the parents until they are able to self-sustain at 12 weeks old. Burrowing owls are different than other owls as they are active during the day time (diurnal) rather than at night (nocturnal) during breeding season. During the non-breeding season, they become more nocturnal.

Habitat and Distribution

Burrowing owls inhabit open prairies in Florida that have very little understory (floor) vegetation. These areas include golf courses, airports, pastures, agricultural fields, and vacant lots. The drainage of wetlands, although detrimental to many organisms, increases the areas of habitat for the burrowing owl. The range of the burrowing owl is throughout the peninsular of Florida in patches and localized areas. Burrowing owls can also be found in the Bahamas (Florida Natural Areas Inventory 2001).

Figure 3-33 Burrowing Owl Distribution

Threats

The burrowing owl faces many threats to its population. The main threat is the continued loss of habitat. Threats to habitat include construction activities development and harassment by humans and domesticated animals. Heavy floods can destroy burrows in the ground, which can cause the destruction of eggs and young. Other threats include increased predation by ground and aerial predators in the burrowing owl's habitat, and vehicle strikes.

http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/burrowing-owl

3.8.4 MIGRATORY BIRDS

The A-1 project site supports migratory birds. Migratory birds are of great ecological and economic value to this country and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of Americans who study, watch, feed, or hunt these birds throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act (Act), the United States has implemented these migratory bird conventions with respect to the United States. Executive Order 13186 of January 10, 2001 directs executive departments and agencies to take certain actions to further implement the Act. As stated in Executive Order 13186, each agency shall, to the extent permitted by law and subject to the availability of appropriations and within budgetary limits, (1) support the conservation intent of the migratory bird conventions and avoid or minimize impacts on migratory bird resources, (2) restore and enhance the habitat of migratory birds, as practicable, (3) prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable, (4) design migratory bird habitat and population conservation principles, measures, and practices into agency plans and planning processes as practicable and coordinate with other agencies and nonfederal partners, (5) ensure that agency plans and actions promote programs of comprehensive migratory bird planning efforts, (6) ensure environmental analysis of Federal Actions required by NEPA evaluate the effects of actions on migratory birds with emphasis on species of special concern, (7) provide notice to the USFWS in advance of conducting an action that is intended to take migratory birds, (8) minimize the intentional take of species of concern, and (9) identify where unintentional take reasonable attributable to agency actions is having or is likely to have a measurable negative effect on migratory bird populations. For a complete list of the requirements in the Executive Order, please refer to the Presidentail Documents, Federal Register, Volume 66, Number 11 dated January 17, 2001 *Responsibilities of Federal Agencies to Protect Migratory Birds.*

3.9 CULTURAL, HISTORIC AND ARCHEOLOGICAL RESOURCES

3.9.1 PROJECT SITE

The A-1 project site has been the subject of multiple cultural resource investigations to determine the presence of cultural, historical and archeological resources. In 2006, the State Historic Preservation Officer (SHPO) reaffirmed the findings from the December 2002 determination that no historic or cultural resource sites eligible for listing in the *National Register of Historical Places* (NRHP) were encountered on the A-1 project site and due to the site being heavily impacted by sugar cane and sod cultivation practices, no additional cultural resource investigations are necessary.

Most recently, the Florida State Bureau of Archaeological Research (BAR) on behalf of the SFWMD, conducted a Phase I Cultural Resource Assessment Survey (CRAS) of 16,593 acres of the EAA A-1 project area in July 2012, as part of the Central Everglades Planning Project (CEPP). This CRAS was intended to locate, identify, delineate, and evaluate cultural resources in advance of proposed landscape modification. The CRAS recommended no further archaeological work at the A-1 property at this time. (*A Cultural Resource Assessment Survey of the EAA A-1 Property, Palm Beach County, Florida, Bureau of Archeological Research, Division of Historical Resources, Department of State, State of Florida, September 2012).*

The EAA A-1 CRAS was undertaken to comply with Section 106 of the National Historic Preservation Act (NHPA) and Section 267 of the Florida Statutes. Section 106 of NHPA of 1966 (PL89-665, as amended) requires federal agencies to take into account the effects upon historic properties of projects involving federal funding, federal permitting, or occurring on federal lands. The Code of Federal Regulations (CFR) Title 36, Chapter VIII, Part 800 (36 CFR 800) contains the guidelines for fulfilling the provisions of Section 106. The study evaluated all potential cultural resources in the project area for eligibility for the NRHP. Cultural resources include archaeological, architectural, prehistoric, and historical sites and artifacts. Similarly, Section 267 of the Florida Statutes requires that "each state agency of the executive branch having direct or indirect jurisdiction over a proposed state or state-assisted undertaking shall, in accordance with state policy and prior to the approval of expenditure of any state funds on the undertaking, consider the effect of the undertaking on any historic property that is included in, or eligible for inclusion in, the National Register of Historic Places".

The July 2012 BAR CRAS of the EAA A-1 project area identified no cultural resources that they believed to be eligible or potentially edigible for listing in the NHRP. Investigations included both archival research and fieldwork and were designed to determine the presence of cultural resources. A search of archives in the Florida Master Site File (FMSF) revealed that there were no known archaeological sites or historic proterties within the project area. Fieldwork consisted of pedestrian walk-over survey with concurrent ground inspection and shovel testing to detect possible subsurface archaeological resources. The field methodology was tailored to the area's unique environmental conditions. As with other survey methodologies in the EAA (Carr 1974; Carr et al. 1996; Carr et al. 2000; Marks and Arbuthnot 2008; Smith 2007), investigations were focused on potential tree island locations (extinct or extant) and other landscape anomalies identified in modern and historic aerial imagery. Field crews found no cultural materials greater than 50 years old in any of the shovel test pits. The remains of the Talisman Sugar Mill (8PB15974), an agricultural facility that was constructed in 1962 and demolished in the late 1990s, were recorded.

The BAR concluded and the USACE agrees that the lack of significant (i.e. NRHP eligible) cultural resources in the EAA A-1 project area is likely because the inhospitable pre-drainage environment limited opportunities for extensive human occupation. Before drainage, the A-1 project site was in the Sawgrass Plains, a sparsely inhabited landscape that was covered in sawgrass and typically submerged under 1.5 ft of water (McVoy et al. 2011). Additionally, any archaeological sites, which may have been present, may have been destroyed through the decades of soil subsidence due to drainage and agriculture work that resulted in severe demucking. Some areas also likely lost soil due to oxidation and burning of dry muck due to over-drainage (FWCC 2002:10–11).

3.9.2 DOWNSTREAM AREAS

Within the larger region of the Everglades, there are numerous recorded archeological sites indicative of Native American habitation. Prior to European contact, the Everglades were a populated area. Native Americans traveled via canoe and on foot through the saw grass and inhabited many of the tree islands. The earliest known habitation sites date to the Early Archaic Period (7,500 BC) when the Everglades were much drier. However, within the larger area of south Florida, evidence of Paleo-Indian (12,000 to 7,500 BC) habitation has also been recorded (i.e. Warm Mineral Springs (8SO18) and Little Salt Spring (8SO79) (Griffin 1988). Some of the Early Archaic habitation sites have only recently been rediscovered as the result of managed drainage programs in south Florida. As the climate warmed and water levels rose, many Native Americans abandoned the lowest of the tree islands as they became submerged. This process continued through what is known as the Middle Archaic, until climate conditions stabilized around 3,000 BC at the start of the Late Archaic. Today many sites from both the Early and Middle Archaic Periods are no longer submerged and may have been utilized by more recent Periods.

After the Archaic Period, the region became incorporated into what is known as the Glades region and remained inhabited until the European arrived in the 1500's. Many of the tree islands through this portion of the Everglades have sites associated to the Glades Period. This Period has been broken down into successive stages starting with Glades I Period, which dates from 500 BC to 750 AD, Glades Period II dating from 750 to 1,200 AD, and Glades Period III dating from 1,200 AD to European contact in the 1,500s. Typical habitation sites through this region are identified by middens, which are the remains of the accumulation and disposal of daily life activities on these tree islands, or hammocks. Material remains may extend from the surface to well over one meter in depth. Native American burials may also be found among these hammocks.

The arrival of Europeans introduced Old World diseases to which the indigenous population has little or no resistance; that and slave raising further reduced the Native American until their populations were decimated. The Native American populations in the region remained at low levels until the early 18th Century when the Miccosukee Tribe of Indians of Florida (Miccosukee Tribe) and the Seminole Tribe of Florida (Seminole Tribe) moved into the area while fleeing the U.S. Army and U.S. Governments' forced relocation program. Many archeological sites associated with both the Miccosukee and Seminole Tribes are known to exist throughout the region.

The USACE has evaluated the downstream areas for the presence of cultural resource sites within STA 2, STA 3/4, WCA 2, and WCA 3. A review of the Florida Master Site Files' digital database has shown that there are no known cultural resource sites within STA 2, STA 3/4, WCA 2A and the upstream area WCA 1. The database has shown that WCA 2B contains three (3) sites, one of which is potentially eligible to be listed on the NRHP. WCA 3A contains 75 potential sites. As stated in the final EIS for the Everglades Restoration Transition Plan (ERTP), WCA 3A and 3B contains 109 reported archaeological sites – 18 of which were the subject of a cultural resource assessment survey. The remaining 91 potential sites were identified based on aerial analysis alone. There have been no significant studies produced as a result of any investigations on the 18 confirmed sites other than identification.

To understand the effects of hydrologic changes on cultural resources within the WCAs, the USACE is developing a predictive model to identify the effects on cultural resources, including an assessment of water management changes in the WCAs. This effort will take multiple years to complete and as such USACE will be implementing a Programmatic Agreement (PA) as specified under ER 1105-2-100 Appendix C4(5)(d)(2) and 36 CFR 800.14b(1)(ii). The PA will allow USACE to complete needed studies on cultural resources within the WCAs.

3.10 TRIBAL RIGHTS

3.10.1 OVERVIEW OF SEMINOLE TRIBE WATER SUPPLY SOURCES

The Seminole Tribe has surface water entitlement rights pursuant to the 1987 Water Rights Compact (Compact) between the Seminole Tribe, State of Florida, and the SFWMD (Pub. L. No. 100-228, 101 Stat. 1566 and Chapter 87-292 Laws of Florida as codified in Section 285.165, F.S.) The Compact contains a series of provisions regarding establishment of Tribal water rights. Specifically, several "entitlements" to surface water were created. Additional documents addressing the Water Rights Compact entitlement provisions have since been executed. These documents include Agreements between the Seminole Tribe, SFWMD, and a SFWMD Final Order.

According to the Compact, the surface water entitlement for the Big Cypress Reservation is based on the percentage of water available within the South Hendry County / L-28 Gap Water Use Basin as the lands of the Big Cypress Reservation are proportional to the total land acreage within the identified basin. The Compact does not address water supply for sustaining tribal natural resources and customary usage rights. The specific volume of water associated with this entitlement was quantified in the 1996 Compact Agreement [1996 Agreement (Appendix O)] between the SFWMD and Seminole Tribe. The 1996 Agreement was precipitated by SFWMD implementation of the Everglades Construction Project (ECP), as required by Section 373.4592, Florida Statutes. Implementation of the ECP diverted surface water from the C-139 Basin and C-139 Basin Annex for treatment, thereby removing a portion of the Seminole Tribe's Big Cypress Reservation surface water entitlement from direct availability for Tribal use. The SFWMD agreed in the 1996 Agreement to first quantify this entitlement volume and protect the Compact right by providing replacement water supplies, as a secondary source, to offset the partial diversion of the entitlement amount. A study was conducted that quantified the Seminole Tribe's entitlement at 47,000 acre-feet per year to be distributed to the Reservation in 12 equal monthly amounts of 3,917 acre-feet. The entitlement right is to be perfected through the annual work plan process. Further, this entitlement volume is to be delivered primarily from the original entitlement source, the North and West Feeder Canals. Only when these volumes are insufficient, reliance on the secondary supply source, the G-409, is appropriate. To accomplish this delivery hierarchy, as well as to appropriately deliver water to the Big Cypress Reservation, an operational plan was developed and has been consistently implemented since 2003.

3.10.2 EXISTING WATER FLOW

Water supply deliveries to the Big Cypress Reservation are made from the North and West Feeder Canal systems via the G-409 pump station located just west of the northwest corner of WCA 3A. Sources of water for this pump station include Lake Okeechobee (delivered via the G-404 pump station), STA 3/4, STA-5, STA-6, Rotenberger and Holey Land WMAs, EAA Runoff, and WCA 3A. Supplemental flows to the Big Cypress Reservation, when demand is not met by the primary supply, are provided from the Miami Canal via G404 and G409. Existing conditions for flows into STA Flow-ways 5-1, 5-2, 5-3, 6-1, and 6-2 are provided from the C139 and C139 Annex Basins. The inflows are currently distributed into the STAs via the L-2/L-3 canal system by impounding water at G-407 in the vicinity of confusion corner (**Figure 3-34**). Inflows into the STAs are treated before discharge into the STA-5/6 discharge canals. The treated flows are directed to the WCA 3A via the L- 4 and Miami Canals. Any flow that cannot be accommodated in the STAs is diverted through G406/G407 into the L-4, similar to past operations.

3.10.3 WCA 3A TRIBAL RIGHTS

The Miccosukee Tribe holds a perpetual leasehold to an 189,000-acre tract of land within the northwest portion of WCA 3A (**Figure 3-35**). The purpose of the lease is to (1) preserve the Leased Area in its natural state for the use and enjoyment of the Miccosukee Tribe and the general public, (2) to preserve fresh water aquatic wildlife, their habitat, and (3) to assure proper management of water resources. The Miccosukee Tribe is allowed to use this land for the purposes of Traditional Cultural Practices (TCP), which include hunting, fishing, frogging, subsistence agriculture, and other activities that are dependent on wet conditions.

The Seminole Tribe also has rights to lands within WCA 3A. In 1989, 14,720 acres in WCA 3A were purchased from the Seminole Tribe with funds from the SFWMD and the Conservation and Recreational Lands (CARL) Program. This tract was added as an amendment to the Rotenberger Wildlife Management Area lease, which names the FWCC as a lead managing agency. The Compact recognized the special status of the Seminole Tribe by acknowledging rights and obligations substantially different from those of other Floridian citizens. The Seminole Tribe has retained non-exclusive rights to utilize the 14,720 acres of land in WCA 3A to hunt, trap, fish and frog. The Seminole Tribe also has full rights of access to the lands in WCA 3A. This amendment has a perpetual flowage easement granted to the SFWMD for the flowage and storage of water.

Public Law 93-440 states that members of the Miccosukee and Seminole Tribes shall be permitted, subject to reasonable regulations established by the Secretary, to continue their usual and customary use and occupancy of Federal or Federally acquired lands and waters within the WCA 3A, including hunting, fishing, trapping on a subsistence basis and traditional tribal ceremonies.

Figure 3-34 Water Flows to Big Cypress Indian Reservation

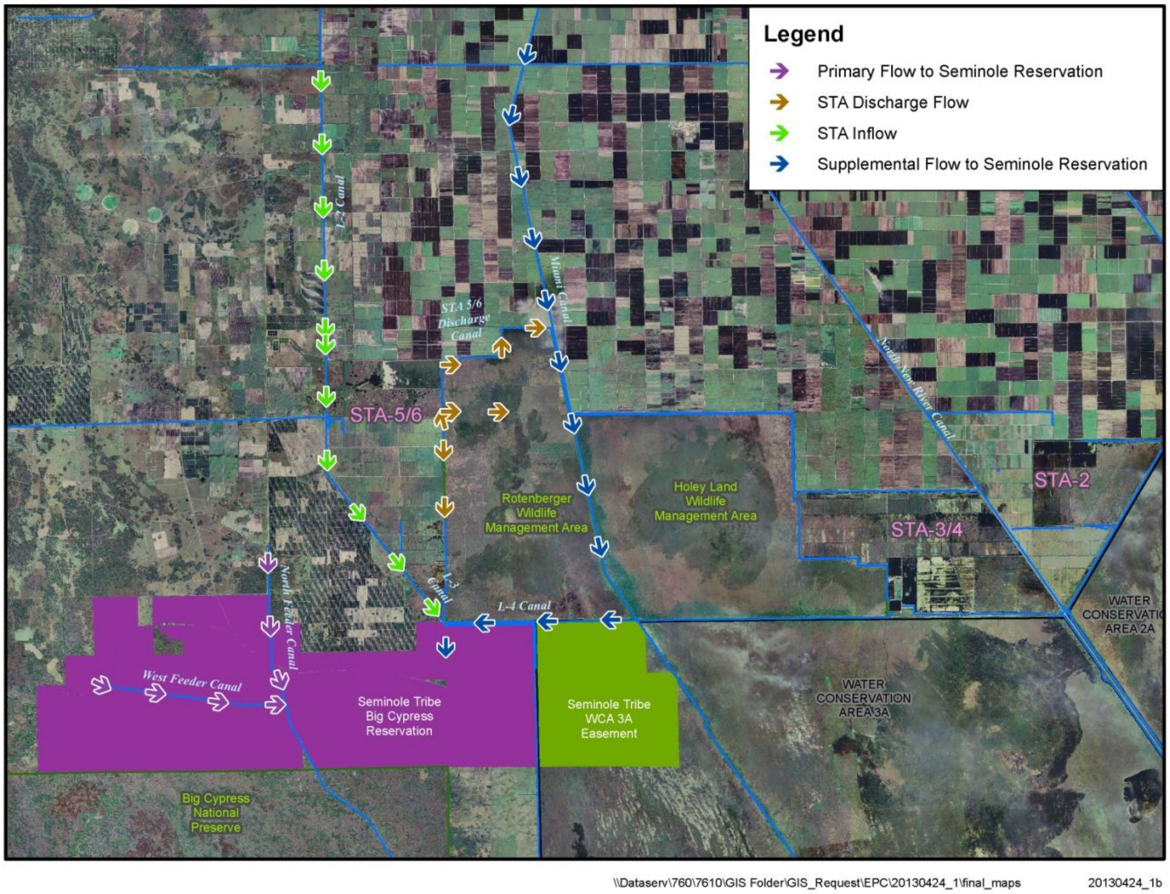
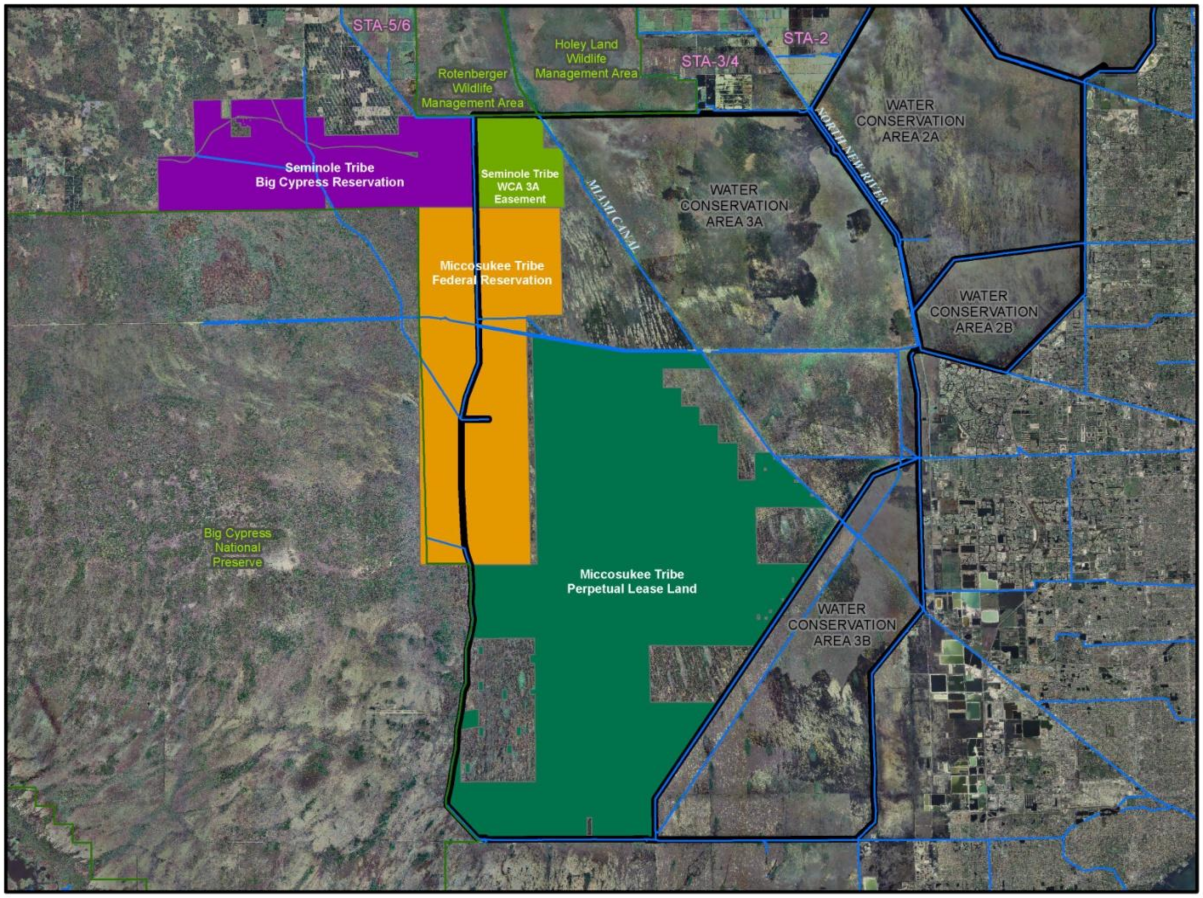


Figure 3-35 Location of the lands leased by the Miccosukee Tribe of Indians of Florida within WCA 3A



3.11 RECREATIONAL RESOURCES

Recreational opportunities are based on a variety of resources, including the waterbodies within the area and several extensive tracts of publicly owned lands. The recreational lands are primarily the existing STAs, which are managed by SFWMD for water quality purposes, or Wildlife Management Areas (WMAs), which are managed by FWCC for public use (primarily hunting and fishing). FWCC also manages hunting within the STAs with a cooperative agreement with SFWMD. The STAs are highly managed and as such public access is limited with no motorized uses allowed within the STAs. Public access, including a variety of motorized uses is permitted in the WMA areas. Due to consistent water levels and managed vegetation, the STAs are abundant in wildlife and are highly desired hunting destinations. The many levees within the STAs allow hiking, biking and limited vehicle access whereas the WMAs are vast without internal levees and are accessed with airboats and tracked vehicles. Overall the STAs and WMAs offer the public a variety of recreational activities that can include hunting, fishing, camping, wildlife observation, interpretation, hiking, bicycling, canoeing, and air boating. The recreational areas within the study area are discussed below.

3.11.1 PROJECT SITE

Currently the project site does not offer any recreational use as it is not open to the public.

3.11.2 STORMWATER TREATMENT AREAS 2 AND 3/4

Hunting is permitted in STA 2 and STA 3/4 and bird watching is allowed in STA 3/4. Recreational plans developed for the STAs ensure that permitted recreational uses are consistent with the primary STA goal of improving water quality.

The STA 3/4 recreational facility, known as the Harold A. Campbell Public Use Area, is located within the footprint of STA 3/4, between the Griffin Rock Pits and Cell 2B. The location of the public use area minimizes public access past the STA's water control structures and data equipment. The Harold A. Campbell Public Use Area includes a vehicle barrier gate, road improvements, a boat ramp, asphalt parking area, an information kiosk (sheltered), landscaping, a multi-purpose bridge, and a composting toilet. The public has access to a 4-mile loop trail during daylight hours on designated days. The boat ramp allows 7-day access during daylight hours to the external canals of STA 3/4 and those canals along the south side of the L-5 levee for a total of 27 miles of fishable canals. FWCC manages waterfowl and alligator hunting in STA 3/4 and STA 2. STA 2 provides access from US Highway 27 through to the WCA 2 and allows fishing along this route. A boat ramp and parking area are located on the east at the shared boundary of the WCA 2 for access into the L-6 Canal.

3.11.3 WATER CONSERVATION AREAS 2A AND 3A

The Everglades-Francis S. Taylor WMA includes WCAs 2A, 2B, and 3A and is located immediately southeast and south of the EAA. The Everglades-Francis S. Taylor WMA is separated from adjacent areas by water control levees and canals, and its hydrology is highly managed. Its 671,831 acres of primarily Everglades marsh buffers ENP and Big Cypress National Preserve from agriculture in the EAA. The main recreational activities within the WMA include hunting, fishing, frogging and air-boating in the interior areas. The levees and canals also provide opportunities for fishing, frogging, hiking, biking, and wildlife viewing. Common access to the western area of WCA 2A and the L-6 Canal between the S6 and S7 pump stations is through the southern portion of STA 2 across the sportsman's crossing. Access to WCA 3 occurs along the north and south boundaries at multiple locations, but the prime access is on the east at Broward County's Holiday Park. The Miccosukee Tribe and the Seminole Tribe also maintain rights to land within WCA 3A. The Tribes have rights to use this land for the purposes of hunting, fishing, frogging, subsistence agriculture, and other activities.

3.11.4 HOLEY LAND WILDLIFE MANAGEMENT AREA

Currently, state agencies (FWCC, SFWMD, and FDEP) are developing an updated management plan to address goals and objectives for restoration of the Holey Land. Recreation includes hunting, fishing, camping, frogging, hiking, and biking. The Holey Land Restoration project that began in 1991 increased the hydroperiod in this WMA. In response, the primary recreational use in the Holey Land changed from hunting deer and feral hog to fishing in perimeter canals and hunting waterfowl (USACE and SFWMD 2006).

3.12 AESTHETICS

The A-1 project site is composed of lands that were historically used for sugar cane farming, with the occasional rotational crop of rice or corn. The site is currently vacant and fallow; the majority of the project lands were formerly part of the EAA A-1 Reservoir project, which was partially constructed before construction was halted due to budgetary and other issues. Construction was halted in 2006 and much of the land has reverted to natural wetland characteristics since that time.

The visual landscape of the STAs and WCAs is overwhelmingly flat. Landscape features include typical canals, levees and prairie wetland communities. The STAs and WCAs offer opportunities for observation of migratory game birds during winter months. Although some of the marshlands have been degraded in visual quality by over-flooding and loss of tree islands, other areas, such as the south-central region of WCA 3A, still preserve good examples of original, undisturbed Everglades' communities, with a mosaic of tree islands, wet prairies, sawgrass expanses, and deeper sloughs. From the elevated viewpoint of the Eastern Perimeter Levee system, the view westward to the marshes is panoramic, though mostly homogenous.

3.13 FLOOD PROTECTION

Runoff from the EAA is collected and routed to the WCAs for flood control (SFWMD 2004). The STAs and WCAs are integral components of the flood protection system in South Florida. STAs work in conjunction with the WCAs to provide flood storage. Runoff from Everglades Tributary Basins is directed first into the STAs, then discharged from the STAs and directed to the WCAs. The flood storage capacity of the WCAs is essential to flood control in the EAA.

3.14 HAZARDOUS AND TOXIC WASTE

Although the project site is no longer in active agriculture use, the past farming activities could have resulted in contamination on the site. Phase I and Phase II environmental site assessments (ESAs) provide a comprehensive overview of the properties and identify point sources including chemical storage and mixing areas, agrochemical and petroleum storage tanks, refueling and maintenance areas, and residual agrochemicals and soil addenda in cultivated areas.

The Phase I and Phase II ESAs identified five tracts of land with potential to contain contaminated soil, groundwater, or surface water (**Figure 3-36**). These tracts are:

- Woerner Farm 3 (Southern 1/3) – Tract No. 100-039
- Talisman South Ranch (Eastern 1/3) – Tract #100-104
- Talisman Mill – Tract
- Cabassa Farm – Tract #100-105
- Farm 21 (northern portion) – Tract #100-020

A description of each tract is described below:

Woerner Farm 3- Tract # 100-039

Tract #100-039 consists of approximately 966 acres of land; however, only approximately 330 acres of the property will be used within the project footprint, plus a small area to the northwest of the FEB footprint that will be used for a construction yard. The northern 2/3 of the property will be outside the project footprint and will serve as a buffer area. The norther 2/3 of Tract #100-039 is currently fallow land, but was historically used for production of vegetables, turfgrass and sugar cane. As part of the previous abandoned EAA Reservoir construction, the east side of the property was utilized as a construction yard and office complex by the contractor. No exit assessment was performed at the time the contractor vacated the property. The southern 1/3 of Tract #100-039 is within the project footprint and has been scraped of soil. The majority of this southern 1/3 portion of the property within the project footprint is now a part of the seepage ditch that was constructed for the EAA reservoir.

The following assessments and investigations were conducted for Tract 100-039:

- A Phase I Environmental Site Assessment - November 1994 and January 1998
- Phase II ESA investigation - February 1999
- Supplemental investigations – February 2000, March 2001, May 2002

- Toxaphene Risk Assessment – October 2005

Three point source areas of concern, including a pump station, a pesticide storage shed, and a pesticide spill area were identified on the eastern portion of the project and required additional assessments and/or corrective actions (Figure 3-37). In 2005, over 1,880 tons of toxaphene impacted soils were excavated from a pesticide spill area. A limited soil excavation of pesticide and petroleum impacted soils was conducted at the former shed on the Woerner tract. In addition 130 tons of petroleum impacted soils were excavated from the main pump station. Concurrence from completion of the remedial activites was obtained from FDEP on all of these point source areas.

In addition to the point source areas, toxaphene was identified throughout the entirety of Tract #100-039 at concentrations that pose a potential ecological risk. An Environmental Risk Assessment (ERA) was prepared and USFWS reviewed the ERA and recommended that SFWMD either conduct corrective action to remove the contaminated soils or avoid inclusion of this tract within the former EAA reservoir boundary. The majority of the portion of Tract 100-039 within the project footprint was scraped of surficial soils during the abandoned EAA reservoir construction and the toxaphene impacted soils may have been largely removed by the scraping. The Woerner Farm 3 site was resampled in 2012 to determine the levels of toxaphene. Four out of the five samples exhibited an average of 60-70% degradation in toxaphene concentrations since 2000, while the fifth sample site exhibited 15% less toxaphene concentrations. Additional sampling is required on this tract to verify that toxaphene concentrations in the remaining soils are below ecological risk thresholds and to verify the disposition of the scraped soils.

Figure 3-36 Location of Potential Point Sources

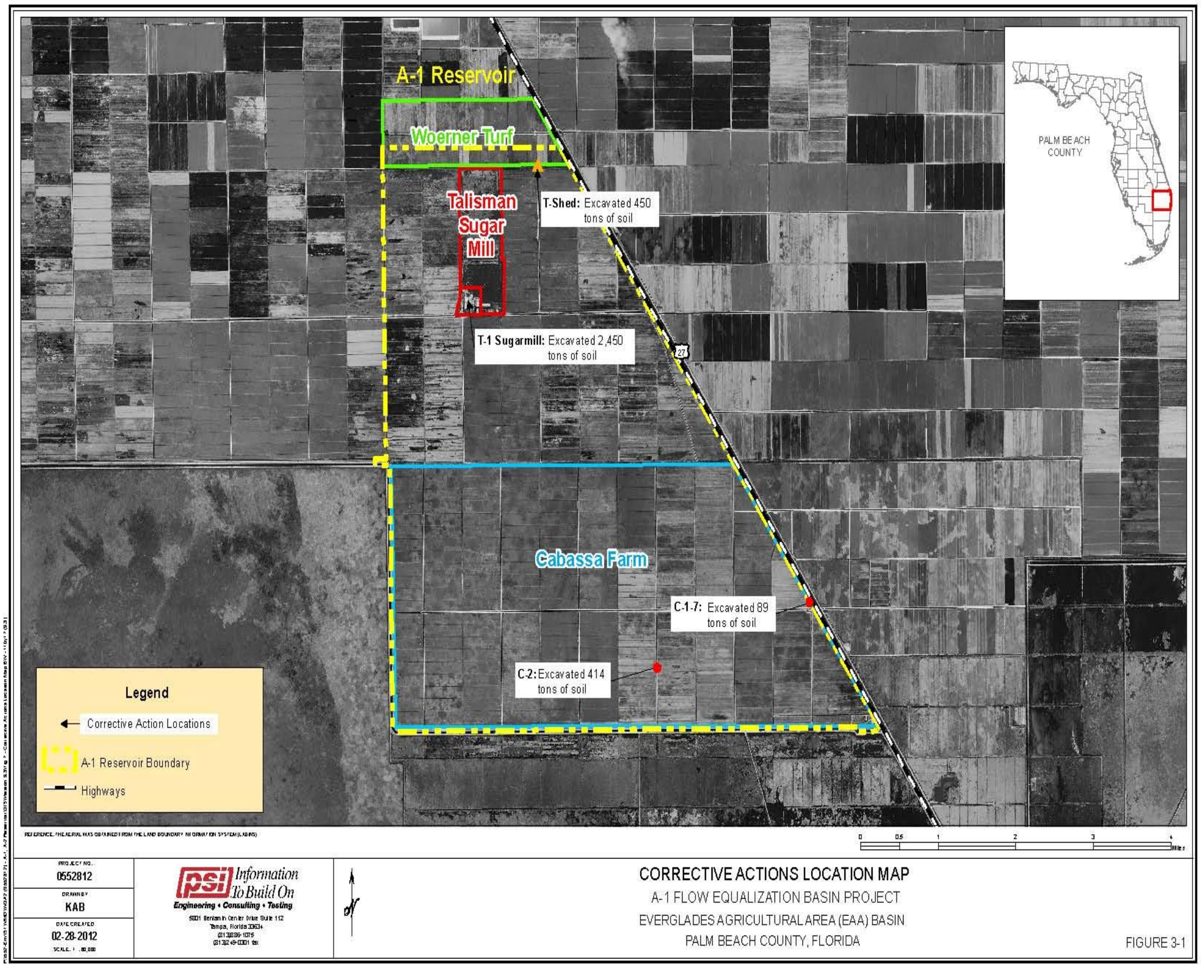
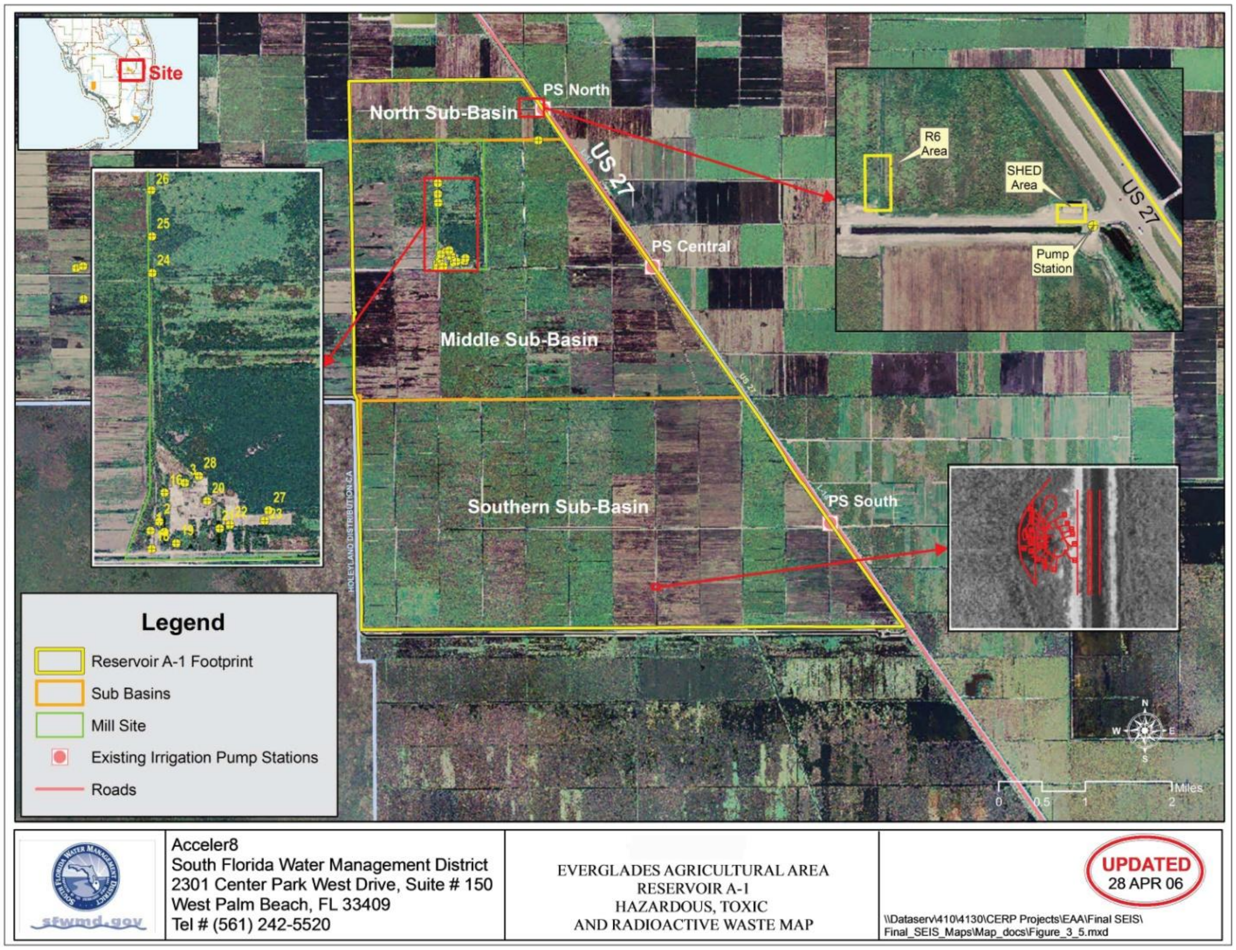


Figure 3-37 Potential Sites with Potential Contaminated Areas



Talisman South Ranch (Eastern 1/3) –Tract #100-104

This property consists of approximately 20,525 acres that has been used for the cultivation of sugar cane since the mid-1960s; however, only an approximate 6,052 acre portion of the property is within the current project footprint.

Phase I and Phase II ESAs were completed in 1998 for the Talisman South Ranch, including both Tract #100-104 and Tract #100-029 (Talisman Mill). No sampling was conducted as part of the 1998 Phase II ESA for the Talisman South Ranch to evaluate residual agrochemical impacts within the cultivated areas. The Phase I and Phase II ESA's identified only one point source area within the A-1 FEB project footprint that required remediation. This point source area (T-SHED) was remediated and a Site Rehabilitation Completion Order (SRCO) was issued by FDEP. Some contaminated soils containing arsenic concentrations above the FDEP residential cleanup target level, but below the commercial cleanup target level were allowed to remain in place. An institutional control (deed restriction) was recorded on this area preventing use of this area for residential or other sensitive purposes. The point source area location is shown on Figure 3-37.

Subsequent to the acquisition of Tract #100-104 by SFWMD, the District conducted follow-up site inspections on the property in 2007 and in 2009, when an agricultural lease on the property expired and the tenant vacated the property. No additional issues were identified during these assessments.

Additionally, SFWMD has recently conducted soil sampling within previously cultivated areas to identify whether any residual agrochemicals are present. Copper was identified in only one of fifteen composite samples at concentrations exceeding the USFWS Interim Screening Level (ISL) of 85 mg/kg. However, the average copper concentration is below the USFWS ISL and the ecological risk associated with copper is believed to be low. Additional soil samples indicate that copper was detected at concentrations that exceed 85 mg/kg in 30% of the samples collected; however the exceedances represent less than 6% of the total project area. Arsenic was also detected in the cultivated areas across the entirety of the site at concentrations exceeding the FDEP residential SCTL, but below the commercial SCTL and the ecological risk threshold. Arsenic is ubiquitous throughout the EAA at similar or higher concentrations and may be associated with farming activities or natural background.

Talisman Mill – Tract #100-029

Tract #100-029 encompasses 530.7 acres and includes the former sugar mill and associated wastewater ponds. The northern portion of the property is improved with a series of bermed infiltration ponds and water management canals. These areas were formerly utilized for sugar cane production, until creation of the infiltration ponds. The southern portion of the property was formerly developed as a sugar mill. Improvements to this area of the property included a sugar mill, associated offices, warehouses, above ground storage tanks, a fleet fueling area, a scalehouse, a cane washing area and other related improvements. The sugar mill and ancillary structures were demolished under the direction of Conestoga Rovers and Associates (CRA) in 1999. Prior to mill demolition, all hazardous materials were removed and properly disposed off-site. All of the petroleum storage tanks were cleaned and removed.

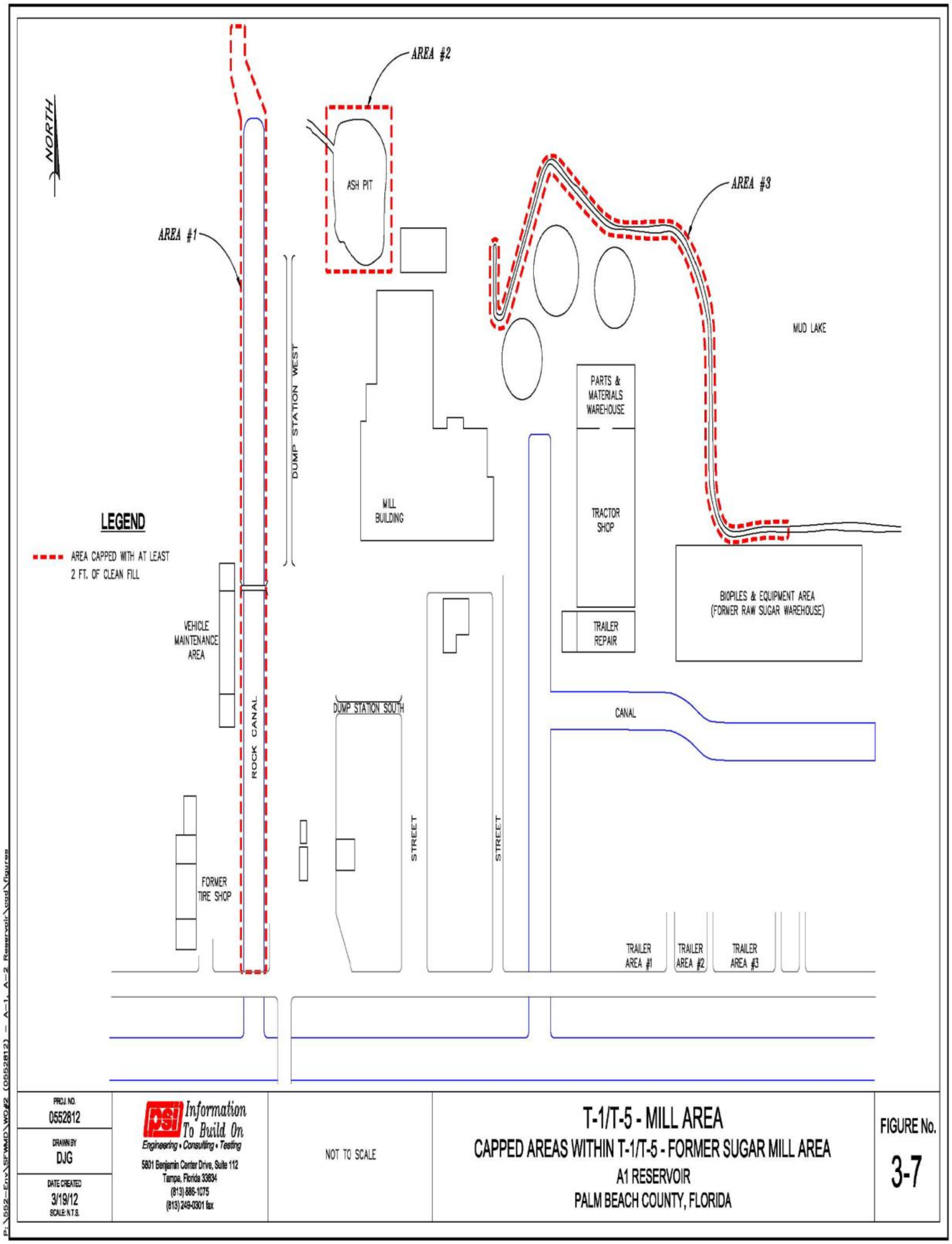
A Phase I and Phase II ESA was completed on both Tract #100-029 and Tract #100-104 in 1998. The Phase I ESA identified 27 separate potential point source areas within Tract #100-029 and all of these areas were investigated as part of the Phase II ESA. Areas of concern at the mill site included numerous leaking petroleum storage tanks, pesticide and/or arsenic impacted soils in the sediments of two drainage canals, an ash pit, and a water storage retention area, and metals-impacted soils adjacent to several building slabs.

Contaminated soil and/or groundwater were identified in 19 of these areas, which were subsequently remediated by the property owner. The assessment and remediation of these point source areas was documented in a number of different reports prepared by PSI dating from 2000 to 2003. Upon completion of the remediation of all of the point source areas, FDEP issued a single SRCO for the entirety of Tract #100-029.

Contaminated soil exceeding the FDEP residential soil cleanup target levels (SCTLs), but below the commercial SCTLs and ecological risk thresholds was allowed to remain in place throughout the tract. Additionally, contaminated soils exceeding the commercial SCTLs and ecological risk thresholds were consolidated in three small areas within the mill and were capped with 2 feet of clean soil to prevent future exposure of the soil to wildlife or people. The locations of these capped areas are shown on Figure 3-38. These areas should not be disturbed during construction, but should pose no significant risk during or after project construction, if left undisturbed. A deed restriction was placed on the entirety of Tract #100-029 to prevent its use for residential or other sensitive purposes. Additionally, the deed restriction prohibits disturbance of the cap in the previously mentioned contaminated soil consolidation areas.

In summary, all of the physical assessment and remediation intended by SFWMD has been completed on all of the point source areas within Tract #100-029 and all of the technical documents relating to the cleanup have been reviewed and accepted by FDEP. No additional assessment, corrective actions, or closures are required on this property.

Figure 3-38 Capped Areas within Former Sugar Mill



Cabassa Farm –Tract #100-105

The Cabassa Farm property consists of approximately 8,846 acres. This property was historically used for the cultivation of sugarcane while the far southeast portion used for rice cultivation. A Phase I and Phase II ESAs were conducted in February and March 1999, respectively. The Phase I and Phase II ESAs identified three point source areas of concern that required additional assessment and/or corrective actions including an equipment maintenance area, a cane loading/equipment staging area, and a permanent pump station (C-1-7).

The pump station was assessed and remediated, as document in a 2002 Site Rehabilitation Completion Report. An SRCO was subsequently issued for the pump station by FDEP. Additionally, an emergency response cleanup and assessment was conducted at another pump station on the Cabassa property in 2001, which was also granted closure and SRCO by FDEP.

A Contamination Ecological Risk Assessment and Corrective Action Report was prepared in January 2002 for this property, which summarized the assessment and remediation activities associated with the areas of concern. As part of the report, a number of composite soil samples were collected from the cultivated aeas, as sampling of the cultivated areas was not included in the 1999 Phase II ESA. Relatively low levels of copper, zinc, and organochlorine pesticides were detercted in the cultivated area soil samples. The results of the ERA concluded that the residual concentrations of pesticides, copper, and zinc were not a threat to representative fish and wildlife species. FDEP concurred with SFWMD's recommendation for No further Action (NFA) for the equipment maintenance area and the cane loading/equipment staging area and the USFWS provided concurrence that the residual agrochemical concentrations in the cultivated crop area did not pose a significant ecological risk.

An abandoned AST was identified during construction of the EAA reservoir on Tract #100-105, which was subsequently removed. A tank closure assessment was performed which did not identify any soil or groundwater contamination and an SRCO was subsequently issued by FDEP.

An exit assessment was performed on Tract #100-105 in 2009, when the agricultural lease on this property expired and the property was vacated by the tenant. Six soil samples were collected to compare the current concentrations to the pre-lease conditions. The report concluded that the agricultural lease operations did not adversely impact the property. USFWS and FDEP both provided concurrence with this report.

No additional assessment, corrective actions, or closures are required on this property.

Farm 21 - Tract #100-020

Tract 49100-020 (Farm 21) is a 3,441 acre parcel that was formerly operated by Okeelanta for sugar cane cultivation. However, only a small 206.9-acre strip on the north side of this tract is included within the A-1 FEB project footprint. A Phase I-II ESA was prepared for Tract #100-020 in 1999. No point source concerns were noted within the portion of Farm 21 that is within the current project footprint; however, numerous concerns were identified to the south, outside the project footprint. Since no concerns were identified on the portion of the property that is within the project footprint, no soil or groundwater samples were collected in this area.

A Contamination Assessment, Ecological Risk Assessment, and Corrective Action Report for STA-3/4 was prepared in 2002, which included Tract #100-020, as well as the Cabassa Farm (Tract 100-105) to the north. This assessment included the collection of four composite soil samples from Tract #100-020. No significant impacts were detected. The Ecological Risk Assessment, which is discussed above for Tract 100-105 also covered Tract #100-020 and concluded that there were no significant ecological risks associated with residual agrochemical impacts on this tract. In summary, no additional assessment, corrective actions, or closures are required on this property.

Corrective Actions on the A1 Property:

Numerous environmental reports addressing assessment and corrective action activities have been prepared for each of these tracts. All of these reports are discussed in the A-1 Flow Equalization Basin Summary Environmental Report, dated September 10, 2012, prepared by Professional Service Industries, Inc. (PSI). The Summary Environmental Report also includes a discussion of regulatory review and concurrence on each tract. Information on these reports can be found at the SFWMD's FTP directory at:

ftp://ftp.sfwmd.gov/pub/febeis/A1_summary_report/

FDEP provides primary oversight for point source spills or releases while the United States Fish and Wildlife (USFWS) provides primary oversight for ecological risks. All of the potential point sources within all five tracts have been investigated, remediated as necessary, and have been granted closure by the FDEP by letter dated April 14, 2013 (Appendix J). The USFWS has provided concurrence that no significant ecological risks associated with residual agrochemicals are present on Tracts #100-105 and #100-020. The USFWS issued separate concurrence on the entire A-1 FEB project site by letter dated April 17, 2013 (Appendix J), pending confirmation on remediation of toxaphene impacted soils from the lower 1/3 of the Woerner Farm 3 property and with the understanding that the SFWMD will implement a USFWS-approved start-up monitoring plan for copper which includes surface water, periphyton, and apple snails should they occur onsite.

3.15 CLIMATE

The subtropical climate of South Florida, with its distinct wet and dry seasons, high rate of evapotranspiration, and climatic extremes of floods, droughts, and hurricanes, represents a major physical driving force that sustains the Everglades while creating water supply and flood control issues in the agricultural and urban segments.

Seasonal rainfall patterns in South Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. Of the 53 inches of rain that South Florida receives on average annually, 75 percent falls during the wet season months of May through October. During the wet season, thunderstorms that result from easterly trade winds and land-sea convection patterns occur almost daily. Wet season rainfall follows a bimodal pattern with peaks during May through June and September through October. Tropical storms and hurricanes also provide major contributions to wet season rainfall with a high level of interannual variability and low level of predictability. During the dry season (November through April), rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. However, due to the variability of climate patterns (La Nina and El Nino), dry periods may occur during the wet season and wet periods may occur during the dry season. High evapotranspiration rates in South Florida roughly equal annual precipitation. Recorded annual rainfall in South Florida has varied from 37 to 106 inches, and interannual extremes in rainfall result in frequent years of flood and drought.

Greenhouse gasses produced on the project site as a result of past rock mining and agriculture are primarily carbon dioxide, while other gasses include methane, nitorous oxide, and chloroflourocarbons. According to EPA's 2009 Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, "Executive Summary," "the primary greenhouse gas emitted by human activities in the United States was CO_2 [carbon dioxide], representing approximately 85.4 percent of total greenhouse gas emissions" (EPA 2009). The carbon dioxide produced on the A-1 project site is prodiced from onsite hauling, offsite hauling by truck and rail, and rock quarry equipment.

3.16 COST

The SFWMD has incurred costs with the previous construction from the EAA A-1 Reservoir. These are defined as sunk costs (costs already incurred) for the land and initial earthwork that was conducted and is currently $180,000,000. The SFWMD also conducts routine vegetative maintenance and maintains measures that prohibit public access on the site.

3.17 ENVIRONMENTAL JUSTICE

Under Executive Order 12898, Federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental effects on minority and low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial (with at least one race designated as a minority race under Council on Environmental Quality (CEQ) guidelines (CEQ 1997). Persons whose income is below the Federal poverty threshold are designated as low income.

Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by the National Environmental Policy Act [NEPA]) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997). A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA).

For the environmental justice analysis for this EIS, the project area was examined. The project area is composed of the EAA, which is composed mainly of agricultural lands.

3.18 NATURAL OR DEPLEATABLE RESOURCES

The A-1 project site has been previously utilized for sugar cane and sod farming, but currently the site is not being farmed. Remnant agricultural and remnant infrastructure still exists throughout the site including agricultural ditches and degraded roads. As a result of permitted construction activities to construction the A-1 Reservoir, the SFWMD has excavated rock material on the project site. Limestone, composed of the mineral calcite, is the primary rock formation which is appropriate for use in building materials and as aggregate for road beds.

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