

**Biological Assessment
for the
Turkey Point Nuclear Generating Unit Nos. 3 and 4
Proposed Subsequent License Renewal**

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Abbreviations, Acronyms, and Symbols

°C	degrees Celsius
°F	degrees Fahrenheit
CCS	cooling canal system
CFR	<i>Code of Federal Regulations</i>
cm	centimeter(s)
COL	combined license (combined construction and operating license)
DERM	Miami-Dade County Department of Environmental Resources Management
EAI	Ecological Associates, Inc.
ECOS	Environmental Conservation Online System
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973, as amended
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FPL	Florida Power & Light Company
FR	<i>Federal Register</i>
FFWCC	Florida Fish and Wildlife Conservation Commission
FWS	U.S. Fish and Wildlife Service
g	gram(s)
GEIS	Generic Environmental Impact Statement
ha	hectare(s)
IPaC	Information for Planning and Conservation
km	kilometer(s)
m	meter(s)
mm	millimeter(s)
NMFS	National Marine Fisheries Service
NRC	U.S. Nuclear Regulatory Commission
ppt	parts per thousand

psu	practical salinity units
SEIS	supplemental environmental impact statement
SFWMD	South Florida Water Management District
SWPP	stormwater pollution prevention
Turkey Point	Turkey Point Nuclear Generating Unit Nos. 3 and 4

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this biological assessment to support the agency's review of Florida Power & Light Company's (FPL's) application requesting subsequent license renewal for Turkey Point Nuclear Generating (Turkey Point) Unit Nos. 3 and 4 (FPL 2018a). If the NRC takes the proposed action and issues the renewed licenses, it would authorize FPL to operate Turkey Point Unit No. 3 (Renewed Facility Operating License No. DPR-31) and Unit No. 4 (Renewed Facility Operating License No. DPR-41) for an additional 20 years past the end of their current licenses or until 2052 and 2053, respectively. This biological assessment also demonstrates the NRC's compliance with the provisions of Section 7, "Interagency Cooperation," of the Endangered Species Act of 1973, as amended (ESA). Section 7 of the ESA is the mechanism Federal agencies use to ensure that their actions (including licensing) will not jeopardize the continued existence of any plant or animal species federally listed as endangered or threatened.

In this biological assessment, the NRC staff examines the potential impacts of the proposed Turkey Point Unit Nos. 3 and 4 subsequent license renewal on the following 15 federally listed endangered or threatened species:

- Florida bonneted bat (*Eumops floridanus*)
- Florida panther (*Puma concolor coryi*)
- West Indian manatee (*Trichechus manatus*)
- red knot (*Caladris rufa*)
- piping plover (*Charadrius melodus*)
- wood stork (*Mycteria americana*)
- Everglade snail kite (*Rostrhamus sociabilis*)
- Kirtland's warbler (*Setophaga kirtlandi*)
- Blodgett's silverbush (*Argythamnia blodgettii*)
- Cape Sable thoroughwort (*Chromolaena frustrata*)
- Florida semaphore cactus (*Consolea corallicola*)
- sand flax (*Linum arenicola*)
- Florida bristle fern (*Trichomanes punctatum* ssp. *floridanum*)
- eastern indigo snake (*Drymarchon corais couperi*)
- American crocodile (*Crocodylus acutus*)

In addition, the NRC staff evaluates the potential impacts of the proposed action on the designated critical habitats of two of the above species: the American crocodile and the West Indian manatee.

The NRC staff used the U.S. Fish and Wildlife Service's (FWS's) Environmental Conservation Online System (ECOS) Information for Planning and Conservation (IPaC) tool to search for federally listed endangered or threatened species that may be present in the action area (see Section 4.1, for a description of the action area). The ECOS IPaC tool identified 42 species federally listed as endangered or threatened and under the FWS's jurisdiction that could occur in the action area. The tool also identified designated critical habitat for two of these species, and found four species that could occur in the action area that fall under joint FWS and National Marine Fisheries Service (NMFS) jurisdiction (see Enclosure 1 to this report, "Summary of Federally Listed Species under U.S. Fish and Wildlife Jurisdiction for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 Subsequent License Renewal Review").

The NRC staff also searched for proposed species and candidate species that may occur in the action area (species that have been proposed for Federal listing or are under review or have been reviewed for Federal listing, but are not listed). No proposed species, candidate species, or proposed designated critical habitats occur within the action area as defined in Section 4.1 (FWS 2018a).

Table 1 in Enclosure 1 describes the habitat requirements, occurrence patterns, and Federal status for each of the 42 listed species based on information in FPL's environmental report (FPL 2018a), FPL's response to NRC staff's requests for additional information (FPL 2018b), onsite surveys and monitoring data (e.g., EIA 2017, FPL 2018c), FWS's ECOS IPaC tool, and other available studies and reports. The NRC staff reviewed the occurrence patterns for the 42 species and compared the habitat requirements for each species to the available habitat within the action area to determine which species could occur within the action area. The NRC staff determined that 27 of these species would not occur within the action area for one or more of the following reasons:

- the species has been extirpated from Miami-Dade County, FL
- the species is not known to occur within Miami-Dade County
- the action area contains no suitable habitat for the species (see Table 1 in Enclosure 1)

Based on this information, the NRC staff finds that the proposed action would have no effect on these 27 species. For the four species under the joint jurisdiction of FWS and NMFS, the NRC staff finds that the proposed action would result in no effect for the portion of the life cycle of these four species under the FWS's jurisdiction (NRC 2018; see Enclosure 1).

2.0 Consultation History

2.1 Informal Consultation for License Renewal

In 2001, while reviewing the Turkey Point initial license renewal application, the NRC first initiated Section 7 consultation under the ESA with FWS regarding Turkey Point. During this consultation and in the biological assessment for the initial license renewal application, the NRC staff considered the potential adverse effects of Turkey Point initial license renewal on 23 federally listed endangered or threatened species (NRC 2001). In its 2001 biological assessment, the NRC staff concluded that the Turkey Point initial license renewal would either (1) have no effect or (2) may affect, but not likely to adversely affect, the 23 federally listed species. In December 2001, the FWS (2001a) concurred that the proposed initial Turkey Point license renewal would not adversely affect any listed species.

2.2 Formal Consultation Following Vehicle Collision

In 2006, the NRC (2006a) requested initiation of formal consultation with the FWS for ongoing operation of Turkey Point after a vehicle collided with a juvenile American crocodile on the Turkey Point site. The American crocodile was the only species considered during this consultation. As a result of the consultation, in May 2006, the FWS (2006a) issued a biological opinion. After this issuance, a vehicle at Turkey Point again collided with a crocodile, which resulted in mortality. This vehicular collision caused FPL to exceed its initial incidental take limit for American crocodiles. In response, in August 2006, the FWS (2006b) issued a modified biological opinion for the American crocodile. That 2006 biological opinion remains in effect today.

2.3 Informal Consultation for Extended Power Uprate

In 2011, following FPL's license amendment request for an extended power uprate at Turkey Point, the NRC (2011a) prepared a biological assessment and requested initiation of informal consultation in a September 2011 letter to the FWS (NRC 2011b). This 2011 biological assessment considered the American crocodile, its critical habitat, and 30 additional listed species that occur in Miami-Dade County. The FWS (2011) concurred with the NRC's conclusion that the proposed action (extended power uprate) would not adversely affect the American crocodile or any listed species and concluded consultation in October 2011.

2.4 Informal Consultation for Increase of the Ultimate Heat Sink Temperature

In 2014, following FPL's license amendment request to increase the ultimate heat sink temperature at Turkey Point, the NRC (2014a) prepared a biological assessment and requested initiation of informal consultation in a July 25, 2014 letter to the FWS (NRC 2014b). This 2014 biological assessment considered the American crocodile and its critical habitat. The FWS (2014a) concurred with the NRC's conclusion that the proposed action (increase of the ultimate heat sink temperature) would not adversely affect the American crocodile or any listed species and concluded consultation in July 2014.

3.0 Description of the Proposed Action

The proposed action is the NRC's decision whether to issue subsequent renewed operating licenses for Turkey Point Unit Nos. 3 and 4 authorizing an additional 20 years of operation after the expiration of the current licenses. The current Turkey Point licenses are set to expire in July 2032 (Unit No. 3) and April 2033 (Unit No. 4). If issued, the subsequent renewed operating licenses would allow Turkey Point Unit No. 3 to operate until July 2052 and Unit No. 4 to operate until April 2053. The biological assessment includes the potential impacts from the date that the subsequent renewed operating licenses would be issued because the FWS's Biological Opinion would cover activities that could occur during the remaining period of performance (i.e., before 2032 and 2033, respectively) as well as during the extended period of performance.

Operations during the remaining period of performance and the extended period of performance would include the continued operation of the current cooling system, which withdraws water from and discharges water into the Turkey Point site's cooling canal system (CCS), as described in Section 4.2.1,. No new construction would occur as a result of continued operations. FPL's (2018a and 2018b) landscape maintenance and operational activities would remain similar to those currently conducted. The practices primarily consist of mowing, weed and hedge trimming, physical or chemical weed removal, herbicide application, tree trimming, brush removal, debris removal, and the maintenance and repair of plant infrastructure such as roadways, piping installations, fencing, and security-related structures. In-scope transmission lines are limited to transmission lines located within the Turkey Point site.

4.0 Description of the Project Area

4.1 Action Area

The implementing regulations for Section 7(a)(2) of the ESA (Title 50 of the *Code of Federal Regulations* (50 CFR) 402.02, "Definitions") state that "action area means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved

in the action.” The action area effectively bounds the analysis of ESA-protected species and habitats because only species that occur within the action area may be affected by the Federal action.

For the purposes of the ESA analysis for the proposed Turkey Point subsequent license renewal, the NRC staff defines the action area as:

- 1) the Turkey Point site (including the CCS)
- 2) wetlands adjacent to the Turkey Point site
- 3) areas in Biscayne Bay where barges may travel

Most potential impacts associated with the proposed action would be confined to the Turkey Point site. However, continued Turkey Point operations would necessitate occasional delivery of large power plant parts and equipment by barge through Biscayne Bay. Thus, Biscayne Bay is included in the action area.

The NRC staff expects all direct and indirect effects of the proposed action to be contained within the action area as defined above. The NRC staff recognizes that while the action area is stationary, federally listed species can move in and out of the action area. For instance, a migratory bird species could occur in the action area seasonally as it forages or breeds at or near Turkey Point. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area, but also those species that may passively or actively move into the action area for limited periods of time. The staff then considers whether the life history of each species makes the species likely to move into the action area where it could then be affected by the proposed action.

4.2 General Plant Information

Turkey Point is a two-unit, nuclear-powered, steam electric generating facility. Turkey Point Unit Nos. 3 and 4 have a reliable net summer rating of 811 and 821 megawatts-electric, respectively, and a combined output of 1,632 megawatts-electric. The Turkey Point site also includes retired Unit Nos. 1 and 2 (formerly operated as natural-gas/oil steam-generating units) and Unit No. 5 (a currently operating natural-gas combined-cycle steam-generating unit). The NRC does not license or regulate the operation of Unit Nos. 1, 2, or 5.

In a separate licensing action, in April 2018, the NRC approved the combined construction permits and operating licenses (COLs) for two new nuclear reactors (Unit Nos. 6 and 7) at Turkey Point. FPL has not begun construction on Unit Nos. 6 and 7. Within its most recent 10 year power plant site plan, FPL identified Unit Nos. 6 and 7 as a preferred site for future generation; however, FPL also determined that Unit Nos. 6 and 7 would not be in service by 2027 (FPL 2018d). For the purposes of this analysis, the NRC staff determined that it was reasonable to assume that construction would likely take place during the proposed Turkey Point Unit Nos. 3 and 4 subsequent license renewal period.

4.2.1 Cooling System Overview

Turkey Point Unit Nos. 3 and 4 are pressurized-water reactors that use a closed-cycle heat dissipation cooling system. In a pressurized-water reactor, water is heated while under pressure to high temperatures. Three heat exchange loops perform cooling functions. The first loop is the primary coolant loop. In this loop, water that has been heated in the reactor passes through a steam generator where heat is transferred from the water in the primary coolant loop

to water in a secondary loop before returning to the reactor. In this heat transfer process, neither the water in the primary loop nor the water in the secondary loop come into contact with each other. The heated water in the secondary loop is allowed to flash into steam. This steam drives the turbines, which then produce electricity. The steam-filled secondary loop then enters a condenser, where water from a third loop removes heat from the steam in the secondary loop. In the condenser, water in the third loop increases in temperature while the steam water in the secondary loop decreases in temperature until it finally condenses from steam back to liquid water. The liquid water in the secondary loop then returns to the steam generator to be reheated.

The third loop is known as the cooling water loop. The primary function of the cooling water loop is to transport heat energy from the water in the reactor out into the environment. As mentioned above, during the transfer of heat from water in the primary coolant loop to water in the secondary loop, the two sources of water do not come into contact with each other. Likewise, in the condenser, the water in the secondary loop and the water in the third loop (the cooling water loop) also do not come into contact with each other. From the condenser, water from the cooling water loop is discharged into a body of water called the CCS.

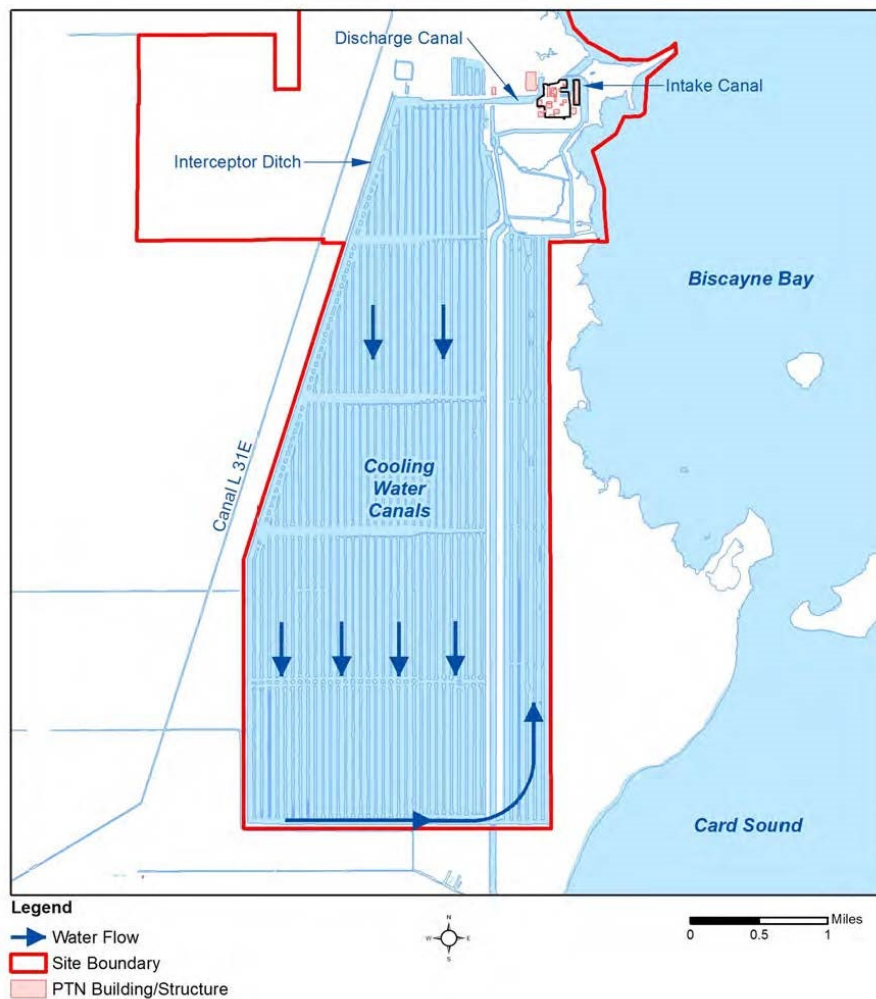


Figure 1 Flow of Water Through the Turkey Point Cooling Canal System

4.2.2 Cooling Canal System Overview

FPL built the CCS in the 1960s to act as a cooling reservoir for multiple electric generating units at the Turkey Point site and as an industrial wastewater facility for liquid discharges from all operations at the Turkey Point site. Historically, the CCS provided cooling water for Unit Nos. 3 and 4 as well as Unit Nos. 1 and 2, which were fossil-fueled units that began operating in 1967 and 1968, respectively, and were retired by 2016. In 2007, FPL began operating Turkey Point Unit No. 5, a 1,150 megawatts-electric combined-cycle, gas-fired power plant that also uses the CCS for cooling water. As noted above, the NRC does not license the operation of Unit Nos. 1, 2, or 5.

At Turkey Point, the cooling water loop withdraws water from and discharges it back to the CCS. The CCS is closed to the public and does not directly connect to any other surface water bodies. The State of Florida does not consider the CCS to be “waters of the U.S.” or “waters of the State” under the Federal Water Pollution Control Act of 1972, as amended (i.e., the Clean Water Act) (33 U.S.C. 1251 et seq.). Instead, the State classifies the CCS as an industrial wastewater facility.

Prior to the construction of Turkey Point Unit Nos. 3 and 4, the cooling system for Unit Nos. 1 and 2 was a once-through design. It withdrew water from and discharged water to Biscayne Bay. In response to a 1971 consent decree by the Federal District Court for the Southern District of Florida (United States of America v. Florida Power and Light Company, 1971), FPL built the CCS and substituted it for the original once-through cooling system. The decree includes a requirement that all cooling water used at the Turkey Point facilities must be discharged into a closed-cycle CCS. To comply with this requirement, FPL designed the CCS to ensure that there was no surface water connection to any outside water body (for example, Biscayne Bay or Card Sound) (NRC 2016).

4.2.2.1 Layout and Operation of the Cooling Canal System

The CCS covers an area approximately 2-miles (3.2-kilometers (km)) wide by 5-miles (8-km) long and covers an area of approximately 5,900 acres (2,387 hectare (ha)). The CCS receives heated water from Turkey Point Unit Nos. 3 and 4 from the discharge canal and distributes the water into 32 feeder channels (canals) (see Figure 1). Water in the feeder channels flows south into a single collector channel that distributes water to seven return channels. As the water flows through the channels, heat is lost, largely through evaporation. Water in the return channels flows north, at which point it is at a lower temperature than when it was discharged. Cooling water enters the intake canal and is used to cool Unit Nos. 3 and 4. From Unit Nos. 3 and 4, the water is returned to the CCS to repeat the cycle. Flows through the CCS are approximately 1.3 million gallons per minute (4.9 million liters per minute) (FPL 2018a).

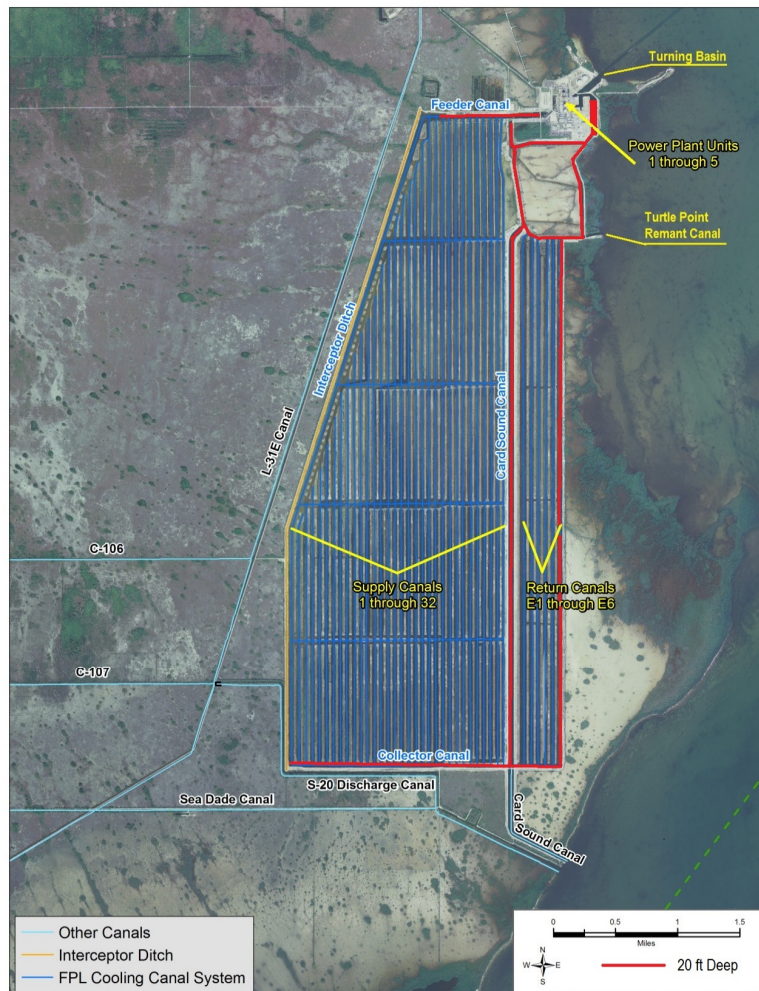
The physical structure of the CCS is best understood as interconnected channels excavated into the underlying bedrock. The bedrock is limestone and forms the top of the Biscayne aquifer. It is important to note that the CCS is not an impoundment that was built up above the land surface. Instead, it was constructed down into the bedrock. Water levels in the channels are below the level of the land surface and below the top of the bedrock (i.e., the top of the Biscayne aquifer). Therefore, the limestone rock of the Biscayne aquifer forms the bottom and sides of the CCS.

Most of the channels within the CCS are about 200-feet (60-m) wide and have a water depth of 1 to 3 feet (0.3 to 1 m). Channels are separated by 90-foot (27-m) wide berms (NRC 2002a).

FPL has excavated a few of the channels within the CCS to a greater depth of approximately 20 feet (6.1 m). These deep channels are:

- 1) the east-west distribution channel along the north side of the CCS
- 2) the east-west collection channel along the south side of the CCS
- 3) the north-south channel within the CCS proper (originally built to discharge water to Card Sound)
- 4) the north-south channel along the east side of the CCS
- 5) a few channels in the northeast corner of the CCS that connect to the intake basin (Golder Associates, Inc. 2008; Morgan & Eklund, Inc. 2010).

In addition to the channels (canals) within the CCS, an 18-foot (5.5-m)-deep interceptor ditch parallels the entire length of the west side of the CCS. The interceptor ditch is not connected to either the CCS or other surface waters. The intended purpose of the interceptor ditch is to keep saline groundwater from beneath the CCS from moving west of the Canal L-31E Levee, which contains freshwater (Figure 2) (FPL 2018a).



Source: Modified from South Florida Water Management District (SFWMD) 2011

Figure 2 Cooling Canal System and Adjacent Canals

Cooling Canal System Maintenance

As water travels through the length of the CCS, heat is lost by evaporation. Evaporation not only removes heat from the water in the CCS, but it also removes some of the water. Water from precipitation is the single largest contributor of water to the CCS. Historically, the second biggest contributor has been saltwater from the Biscayne aquifer via seepage into the CCS. More recently, brackish water supplied by wells that withdraw water from the Upper Floridan aquifer has likely become a larger contributor than the seepage of water from the Biscayne aquifer. These three sources supply most of the water to the CCS and make up for evaporation losses.

The CCS receives relatively minor additions of water from discharges from the interceptor ditch and Turkey Point Unit No. 5 cooling tower blowdown. In extraordinary circumstances, water from wells (marine wells) that withdraw saltwater from the Biscayne aquifer may also be used to add water to the CCS. These marine wells are located on the Turkey Point peninsula near Biscayne Bay and obtain saltwater from the Biscayne aquifer and Biscayne Bay. However, these marine wells are seldom used (FPL 2018a).

As explained earlier, the CCS was designed so that water in the CCS is not in contact with other surface water bodies. However, the water in the CCS is in direct contact with the Biscayne aquifer and with earthen plugs located along the perimeter of the CCS. These plugs seal off remnant canals from the waters in the CCS (FPL 2018a). As the Biscayne aquifer is highly permeable, water would be more readily transmitted through it than through the relatively small areas occupied by the low permeability earthen plugs on the perimeter of the CCS. The perimeter berms are not a pathway for water to seep from the CCS as they are not in contact with the waters of the CCS.

Not only does water leave the CCS via evaporation, some of the water also leaves the CCS via the Biscayne aquifer. However, more water moves into the CCS from the Biscayne aquifer than leaves the CCS via the Biscayne aquifer. FPL (2018a) estimated that the inflow of groundwater from the aquifer into the CCS is about twice the volume of water that leaves the CCS through the Biscayne aquifer.

Sediments can build up in the channels of the CCS. These sediments not only obstruct the lateral flow of water through the system but also lessen the rate of water movement into the system from the Biscayne aquifer. Therefore, CCS maintenance activities include the periodic removal of accumulated sediments (FPL 2018a).

4.3 Affected Environment

As described in Section 4.1, the action area includes the Turkey Point site (including the CCS), adjacent wetland areas, and areas in Biscayne Bay used for barge travel. The sections below describe the terrestrial and aquatic resources located within the action area, including vegetative communities onsite, the CCS and prey species within the CCS, and Biscayne Bay and Card Sound.

4.3.1 Vegetative Communities

The Turkey Point site is located on the western edge of Biscayne Bay and lies within the Mangrove and Coastal Glades physiographic province (McPherson and Halley 1996). This area includes a broad band of wetlands at or near sea level that is often flooded by tides or

freshwater runoff. The ecology at and near Turkey Point is directly tied to the hydrology and natural seasonal hydrologic fluctuations that occur in this region.

NUREG–2176, “Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7” (NRC 2016), and the associated biological assessment (NRC 2015) contain extensive descriptions of the vegetative communities of the southern Miami-Dade County region, focusing on the Turkey Point site but also including the larger action area. Specifically, NUREG–2176, Section 2.4.1.1 and Table 2-3 (NRC 2016) describe the physiographic province and general ecology of the Turkey Point site, as well as the land cover of various habitats within the action area, which includes both the Turkey Point site and some areas around it. NUREG–2176, Section 2.4.1.1 (NRC 2016) also summarizes vegetative surveys conducted on the Turkey Point site through 2011. The NRC staff has incorporated this information from NUREG–2176 into this biological assessment by reference (NRC 2016: 2-76 to 2-77; Tables 2-2 and 2-3). The below paragraphs describe the result of monitoring and modeling studies that have been conducted since the NRC published NUREG–2176 and the associated biological assessment.

FPL developed a vegetative survey monitoring plan as a condition of its site certification from the State of Florida in association with the 2012 extended power uprate (FPL 2018b). This vegetative survey monitoring plan includes surveys of 32 plots of freshwater marsh and mangrove habitat adjacent to the CCS (see Figure 3). FPL initially surveyed these areas in October 2010 prior to the extended power uprate; FPL continues to survey each of these 32 plots of freshwater marsh and mangrove habitat approximately four times each year in February, May, August, and October (FPL 2012a, 2014a, 2016a, 2016b, and 2017a). During each survey, FPL measures the percent of vegetative cover, species diversity, plant height, biomass, and other factors that may indicate changes in the health of the vegetation and habitat. In an area further from the CCS (chosen because the area would not be as susceptible to potential impacts from the CCS), FPL selected one plot and transect (T6) to serve as a reference plot and reference transect. For additional details regarding FPL’s vegetative survey methodology, see, “Turkey Point Plant Comprehensive Pre-Uprate Monitoring Report, Units 3 & 4 Uprate Project” (FPL 2012a).

The most common freshwater wetlands near the CCS are sawgrass marshes. Sawgrass marshes are flooded for the majority of the year. The relative abundance of sawgrass (*Cladium jamaicense*) compared to other species tends to be positively correlated with the length of the hydroperiod, or time during which the area is flooded, as well as the depth of the water (UF undated a; Foti et al. 2012). Vegetative species diversity is generally low within sawgrass marshes because sawgrass plants can grow densely and few other species can establish given the limited space and harsh physiological conditions (Brown et al. 2006). At Turkey Point, spikerush (*Eleocharis cellulose*) is the next most common species after sawgrass. Species diversity generally ranges from one to three species per plot (FPL 2012a, 2014a, 2016a, 2016b, and 2017a), which is typical for southern everglades sawgrass marshes (Childers et al. 2006, Foti et al. 2012). Sawgrass cover has remained between 2-to-25 percent since FPL began sampling in 2011 (FPL 2012a, 2014a, 2016a, 2016b, and 2017a).

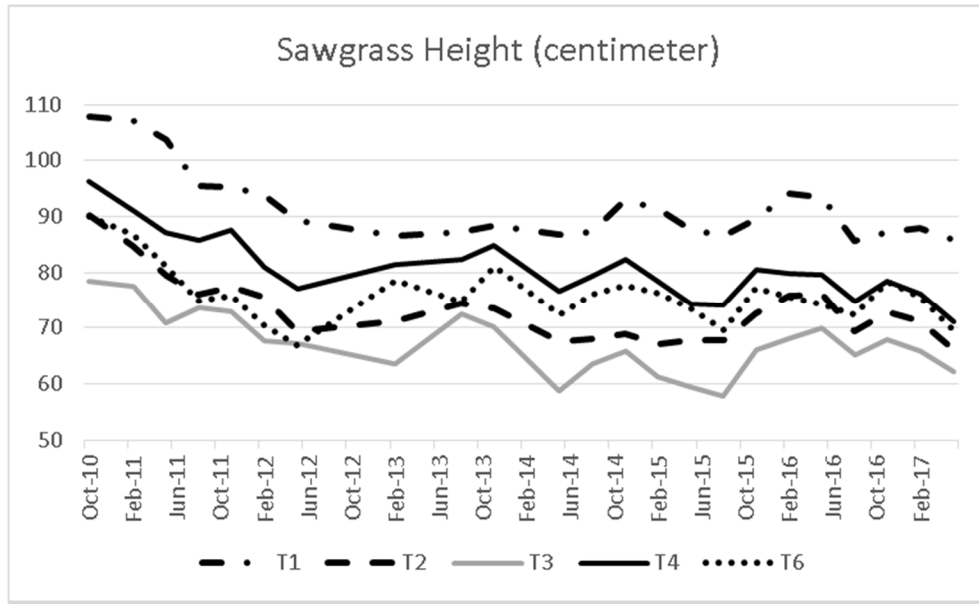
The NRC staff plotted the height of sawgrass plants and live biomass within the five freshwater marsh transects from 2011 through 2017 (see Figure 4 and Figure 5). Sawgrass height tended to be highest during fall and winter and slightly shorter in spring and summer. Average height decreased from October 2010 through February 2012 and has fluctuated ever since without showing a consistent upward or downward trend. Live biomass has also fluctuated over the past several years, also without showing a consistent upward or downward trend. Most

recently, live biomass decreased in August 2016 and again in November 2016 and then increased by February 2017 and remained at a similar or higher level in May 2017. For both sawgrass height and live biomass, the reference transect (T6) exhibited similar growth patterns as the transects closer to the CCS (T1-4). These growth patterns suggest that large, landscape-scale environmental factors, such as the hydroperiod or overall water depth, affect changes in sawgrass growth more so than the distance from the CCS. In addition, the fluctuations in sawgrass height and live biomass over time suggests that there is a high degree of natural variability influenced by multiple environmental parameters.



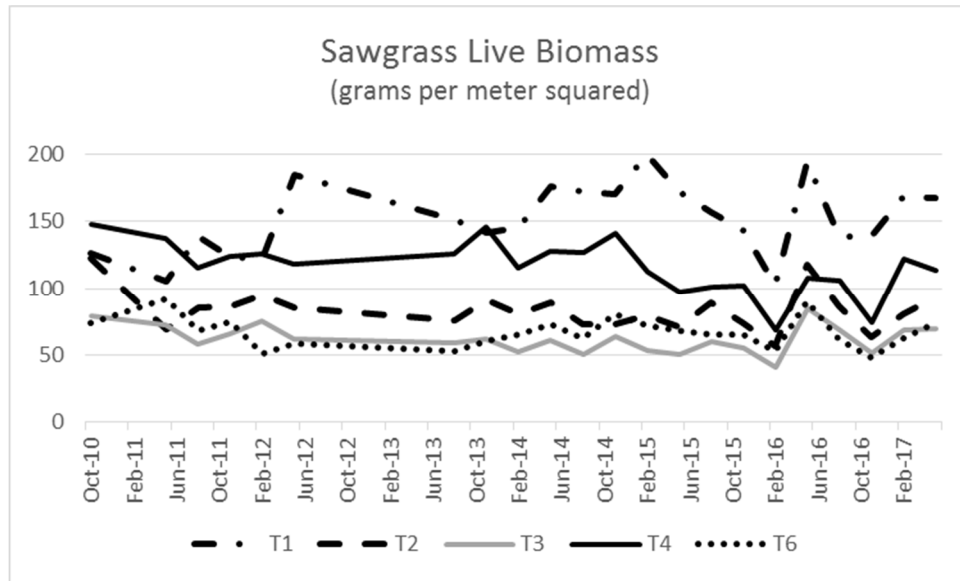
Source: FPL 2016a

Figure 3 Ecological Transect Locations for Florida Power & Light's Vegetative Monitoring Plan



Sources: FPL 2012a, 2014a, 2016a, 2016b, and 2017a

Figure 4 Average Height of Sawgrass Blades Within Freshwater Marsh Transects from October 2011 through February 2017

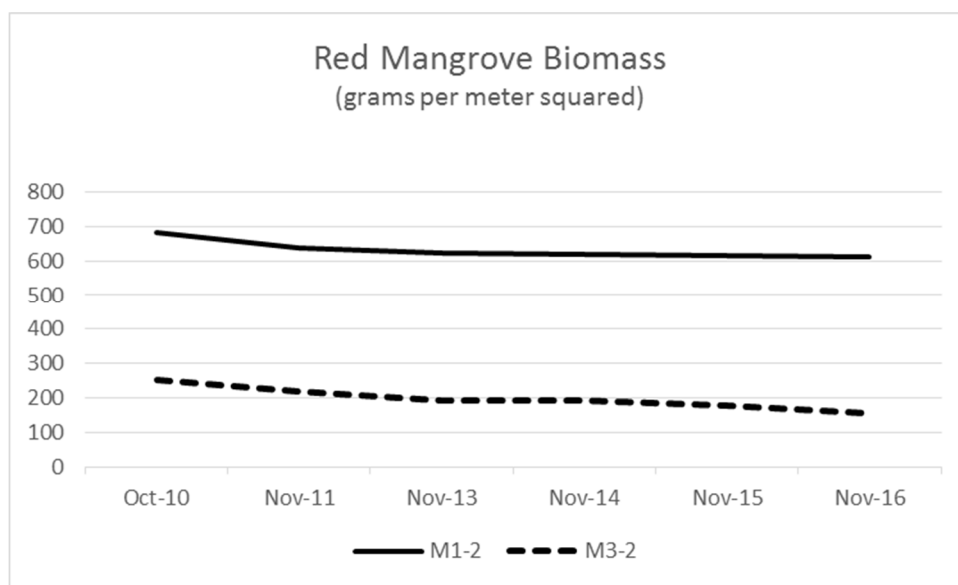


Sources: FPL 2012a, 2014a, 2016a, 2016b, and 2017a

Figure 5 Live Biomass Within Freshwater Marsh Transects from October 2011 through February 2017

In scrub mangrove plots, red mangrove (*Rhizophora mangle*) is the most common species. Red mangrove forests tend to have low vegetative species diversity due to the dominance of red mangrove and because few species have adapted to grow in saline waters, which is physiologically demanding. Similar to biomass trends within freshwater marshes, biomass within most mangrove plots and transects have fluctuated over the past several years, showing no consistent upward or downward trend. However, biomass within two of the mangrove plots

(M1-2 and M3-2) has been steadily decreasing since October 2011 (see Figure 6). FPL (2017a) noted that although biomass has decreased, percent cover and height have remained relatively consistent. FPL stated that it intends to closely monitor these plots in the future.



Sources: FPL 2012a, 2014a, 2016a, 2016b, and 2017a

Figure 6 Live Biomass Within Red Mangrove Plots (M1-2 and M3-2) from October 2011 through February 2017

4.3.2 Cooling Canal System

4.3.2.1 Water Quality

Within the Turkey Point site, the CCS is the largest body of water. This section describes the historical and current levels of salinity, temperature, ammonia, and nutrients within the CCS. As described in more detail below, FPL entered into a consent agreement with the Miami-Dade County Department of Environmental Resources Management (DERM) and a consent order with the Florida Department of Environmental Protection (FDEP) based on the changes in water quality and concerns that water from the CCS was reaching Biscayne Bay and wetlands adjacent to the Turkey Point site. The sections below summarize FPL's plans and activities to mitigate the increased salinity, temperature, ammonia, and nutrients within the CCS.

Salinity Within the Cooling Canal System

Salinity fluctuation within the CCS occurs through a complex process that is influenced by multiple environmental variables. Salinity increases when water leaves the CCS and decreases when less saline water or freshwater enters the CCS. The highest salinities in the CCS generally occur during the dry season when precipitation is low and evaporation rates are high. Conversely, lower salinities within the CCS generally occur during the wet season, when precipitation is high and when evaporation rates are low (FPL 2012a, FPL 2018a).

Most of the salt in the CCS comes from the Biscayne aquifer. As groundwater from the Biscayne aquifer moves into the CCS, the salt it contains also moves into the CCS. The

Biscayne aquifer obtains its salt from Biscayne Bay. The Biscayne aquifer is hydrologically connected to both Biscayne Bay and to the CCS (FPL 2018a, Tetra Tech 2014, FPL 2016a).

Salt is removed from the CCS when water containing salt leaves the CCS, for example by moving into the Biscayne aquifer. Water that moves into the groundwater is likely to reflect the hypersaline conditions of the CCS (currently around 60 practical salinity units (psu)). Because the water in the CCS has higher salt concentrations, it is denser than the ambient groundwater within the Biscayne aquifer (PTN 2918).

In the early 1970s, the salinity within the CCS was close to 34 psu, which is similar to the salinity within Biscayne Bay. Over time, the salinity within the CCS has varied seasonally, primarily based on rainfall levels. During dry years (or periods of drought) the overall salinities at the end of year were higher than at the end of the previous year. As a result, drought years have produced a ratcheting effect that caused the next year to begin the seasonal cycle of salinity concentrations at higher salinities than the previous year. Based on these natural cycles, the average salinity of the CCS gradually doubled from approximately 34 psu in the early 1970s to approximately 70 psu in 2013 (FPL 2018a). During periods of extremely low precipitation, the salinity has been even higher, at times reaching 90 parts per thousand (ppt) (FPL 2017a, Squires et al. 2017).

FPL received permission from the State of Florida on June 27, 2014 to add saltwater from the Biscayne aquifer and brackish water from the Upper Floridan aquifer to the CCS (NRC 2016). The primary purpose of the additional water was to help reduce the temperatures within the CCS, which was also a concern as described below. However, the additional water also served to help decrease salinity levels in the CCS. In August 28, 2014, FPL received permission from the SFWMD to add freshwater from the L-31E Canal to aid in salinity reduction. After these additions and higher precipitation levels, CCS salinities and temperatures returned to pre-summer 2014 levels (around 60 psu) (FPL 2018a, NRC 2016).

Salinity Management Plan for the Cooling Canal System

In December 2014, the FDEP issued an administrative order requiring FPL to submit a salinity management plan describing how the utility will reduce and maintain the average annual salinity in the CCS to at or below 34 psu (FDEP 2014, NRC 2016). On October 7, 2015, DERM and FPL signed a consent agreement (MDC 2015). This agreement acknowledged that FPL would supply brackish water to the CCS from the Upper Floridan aquifer and saltwater from the Biscayne aquifer via marine wells (wells located adjacent to Biscayne Bay). However, FPL would work to avoid the use of water from the marine wells, except under extraordinary circumstances. Secondly, the agreement acknowledged that FPL would continue to use water from the L-31E Canal to lower CCS salinities only until a transition was made to long-term sources of water for the CCS (i.e., brackish water from the Upper Floridan aquifer) (MDC 2015).

On June 20, 2016, a consent order (FDEP 2016a) was executed between FPL and the FDEP. The consent order requires FPL to maintain the average annual salinity of the CCS at or below 34 psu and further states:

If FPL fails to reach an annual average salinity of at or below 34 psu by the end of the fourth year of freshening activities, within 30 days of failing to reach the required threshold, FPL shall submit a plan to the [FDEP] detailing additional measures, and a timeframe, that FPL will implement to achieve the threshold.

Subsequent to attaining the threshold in the manner set forth above, if FPL fails more than once in a 3 year period to maintain an average annual salinity of at or below 34 psu, FPL shall submit, within 60 days of reporting the average annual salinity, a plan containing additional measures that FPL shall implement to achieve the threshold salinity level (FDEP 2016a).

In future years, FPL anticipates that the Upper Floridan aquifer wells will be the water source it uses to reduce salinity in the CCS (FPL 2018a). FPL began operation of the Upper Floridan aquifer freshening well system on November 28, 2016. The addition of this brackish water (2.5 psu) to the CCS is helping to reduce the CCS salinity to an average annual level of 34 psu. The addition of this water has been important in minimizing increases in CCS salinity that ordinarily occur during the dry season. Continued operation of the freshening wells during the wet season should help to further reduce CCS salinities (FPL 2018a).

Temperature Within the Cooling Canal System

The temperature of the CCS varies in response to a number of factors such as heated water discharged by Turkey Point Unit Nos. 3 and 4 into the CCS, air temperature, wind, precipitation, Biscayne aquifer water flowing into and out of the CCS, and well water added to the CCS. To a lesser extent, discharges of water into the CCS from the interceptor ditch and Turkey Point Unit No. 5 cooling tower blowdown can also impact the temperature of water within the CCS.

As described earlier, Unit Nos. 1, 2, 3, and 4 historically contributed heat to the CCS. FPL retired Unit Nos. 1 and 2 by 2016, so these units no longer contribute to the heat load within the CCS. Under current operations (i.e., including heat levels from the 2012 extended power uprate at Unit Nos. 3 and 4), the heat discharged into the CCS from Unit Nos. 3 and 4 is less than the amount of heat that was once discharged into the system when Unit Nos. 1 and 2, and Unit Nos. 3, and 4 were all in operation.

Due to the discharge of heat into the CCS, water temperatures in the CCS are higher than air temperatures (FPL 2018a). Surface water temperatures within the CCS are warmer in the summer months and cooler in the winter months (FPL 2016a). Water temperatures within the CCS also vary based on location. As water moves through the CCS it drops in temperature (FPL 2016a). As expected, within the CCS, the highest water temperatures are found where hot water is discharged from the power plants into the CCS (Station TPSWCCS-1) and the coolest water temperatures occur at the cooling water intake for Unit Nos. 3 and 4. From June 2010 through May 2017, average monthly temperature values collected at seven monitoring stations within the CCS produce an average monthly value of 96 degrees Fahrenheit (°F) (35.5 degrees Celsius (°C)) (FPL 2017a).

The CCS serves as the ultimate heat sink to cool Turkey Point Unit Nos. 3 and 4. The NRC has established an ultimate heat sink inlet temperature limit for the cooling canals of 104 °F (40 °C) (NRC 2014c). Measurements to judge compliance with this limit are taken from the return canal in front of the cooling water intake structure. Data from this sampling location represent the temperature of the water after it has been cooled by the CCS. From June 2010 through May 2017, temperature measurements located in the return canal prior to the intake structure (Station TWSWCCS-6) have not exceeded the 104 °F (40 °C) limit (FPL 2017a).

However, during the period from the initial operation of Turkey Point Unit Nos. 3 and 4 until August 2014, the ultimate heat sink limit was set at 100 °F (37.8 °C). In early July 2014, the water temperature in the cooling canals began to approach this limit. Therefore, after the NRC

performed a safety and environmental analysis, the agency established the current temperature limit of 104 °F (40 °C) (NRC 2014c).

FPL (2018a) stated that the increase in average CCS temperatures in 2014 was the result of the following three factors:

- 1) low average precipitation into the CCS from 2011 through 2014
- 2) poor water circulation through the CCS due to blockages and sediment accumulation
- 3) reduced heat exchange efficiency (i.e., salinity, turbidity, and algal concentrations that reduced evaporation rates)

Since 2014, FPL has worked to reduce algae concentrations, improve canal circulation, and increase Biscayne aquifer water inflow into the CCS by removing sediment from the CCS channels. For a short period of time, to help lower CCS temperatures, freshwater from State canal L-31 was discharged into the CCS as well as brackish water from the Upper Floridan aquifer, and saltwater pumped from the Biscayne aquifer. Current plans do not include the use of freshwater from State canals (FPL 2018a). Should that need arrive in the future, FPL would need to seek permission from Florida State and county governments.

Future plans to reduce CCS temperatures call for the addition of brackish water from the Upper Floridan aquifer, the reduction of algae, continued sediment removal within the CCS, and, only in extraordinary circumstances, the use of saltwater pumped from the Biscayne aquifer (FPL 2018a).

Thermal Efficiency Plan for the Cooling Canal System

In accordance with the June 20, 2016 consent order between FPL and the FDEP, FPL submitted a CCS thermal efficiency plan to the FDEP (FDEP 2016a). FPL has identified that maintaining high thermal efficiency within the CCS is necessary for controlling evaporation and salinity. Therefore, the plan identifies primary and secondary performance metrics to be monitored. These metrics are used to guide actions to maintain high thermal efficiencies (equal to or greater than 70 percent). On July 7, 2017, the FDEP instructed FPL to implement the plan (FPL 2017b).

Near-term actions that FPL has implemented under this plan have included (1) sediment removal in many of the canals in the CCS, (2) flow management within the CCS, (3) water stage management, and (4) vegetation management. As a result, thermal efficiency during the 2017 reporting period met the objectives of the plan, with an annual thermal efficiency for October 2016 through September 2017 of approximately 84 percent (FPL 2017b).

Ammonia and Nutrients within the Cooling Canal System

The decay of organic material within the CCS releases ammonia into its waters. Between June 2010 and May 2016, ammonia concentrations within the CCS ranged from below detection to 0.3 mg/L and averaged 0.04 mg/L. The Miami-Dade County water quality standard for ammonia is 0.5 mg/L. These measured ammonia values in the CCS are all below the county standard.

Ammonia is a nutrient. Other nutrients include phosphorus, chlorophyll, and total nitrogen. Within a surface water body, if the concentration of nutrients get too high, the nutrients can cause algae blooms. Algal blooms can be toxic, deplete oxygen in the water, and reduce water clarity (FDEP 2018).

Nutrients are added to the water in the CCS by the erosion of soil and by vegetation that falls into the canals from the land that separates the individual channels within the system. Nutrients are also added by groundwater inflows, atmospheric deposition (of nitrogen), and by the effluents from power plant operations (such as stormwater runoff). Nutrients are removed from the water by the growth of seagrass, the harvesting of seagrasses as a CCS maintenance activity, the removal of biological material impinged on the plant intake screens, and the outflowing of groundwater from the CCS (FPL 2018a).

Prior to 2010, the CCS operated as a seagrass-based biological system. Seagrass grew beneath the water on the bottom of the channels within the CCS. Seagrass covered approximately 50 percent of the channel bottoms within the system prior to 2010 and provided a habitat for aquatic life, natural filtration of suspended material, and removal of nutrients from the water. This ecosystem helped to maintain water quality and low nutrient concentrations in the water.

However, by 2010, CCS salinities had increased to the point that the seagrass meadows were dying off. By 2012, few seagrass beds remained. The decomposition of the dead seagrasses released a significant volume of nutrients into the waters of the CCS. This in turn facilitated seasonal algae blooms, resulting in high turbidity and generally degraded water quality within the CCS.

Nutrient Management Plan for the Cooling Canal System

In accordance with the June 20, 2016 consent order between FPL and the FDEP (FDEP 2016a), FPL submitted to the FDEP a nutrient management plan for the CCS. The plan is composed of three primary nutrient management strategies: (1) active algae/nutrient removal; (2) canal and berm maintenance; and (3) salinity reduction and controlled flow management. On July 7, 2017, the FDEP directed FPL to implement the plan (FPL 2017b).

Under the nutrient management plan, bench and pilot tests have been performed to find the most appropriate active nutrient/algae removal regime for the unique ecology and water chemistry of the CCS. These methods include application of chemical flocculants/coagulants, removal of nutrients using nonchemical physical methods, and aeration. In addition, FPL reviewed canal practices in order to integrate into them the goal of minimizing erosion and nutrient inputs from sediment and berm sources.

Another initiative of the plan is to re-establish seagrass meadows within the CCS. FPL (2016c) states in its plan that a healthy seagrass population of approximately 50 percent of the surface water acreage would help balance and sequester the system's nutrient content. Seagrasses require nonturbid clear water and near-ocean salinity levels (roughly 30 to 37 ppt). Given the current turbid, hypersaline, and phosphorus-limited conditions in the CCS, FPL is concentrating its efforts on removing or binding bioavailable phosphorus to reduce algae growth. This reduction of algal growth should in turn reduce nitrogen fixation, increase water clarity, and improve the conditions for re-establishment of seagrasses. FPL is currently investigating the direct application of flocculants into the CCS, treatment of CCS water in an external system, and the use of protein skimming methods to actively remove algae and nutrients. Once nutrients are

removed and salinities are lowered, FPL will cultivate and plant seagrass beds within areas of the CCS with appropriate depth and substrate. Some dormant seagrass seeds may also germinate such that seagrasses may reemerge naturally as conditions improve. Once re-established, seagrasses will provide a significant mechanism for uptake and retention of nutrients to deter future algal blooms and improve water clarity issues. FPL's nutrient management plan sets a seagrass colonization target at 50 percent of the CCS water acreage.

4.3.2.2 Aquatic Resources

Within the Turkey Point site, the primary aquatic environment is the CCS. The CCS has historically supported a variety of fish (such as sheepshead minnow (*Cyprinodon variegatus*) and several *Fundulus* species), mollusks, crabs, and submerged aquatic vegetation that are tolerant of shallow, subtropical, hypersaline environments. FPL (2014b) reported that the species identified in Table 1, below, were present in the CCS as of November 2007. Because the water in the CCS does not directly connect to any surface water body, aquatic organisms are unable to travel between the CCS and any other water bodies. Aquatic biota in the CCS are not accessible for recreational or commercial harvest because the entirety of the CCS is owner controlled and closed to the public.

Table 1 Aquatic Species Reported from the Cooling Canal System, November 2007

Species	Common Name
Fish	
<i>Centropomus undecimalis</i>	common snook
<i>Cyprinodon variegatus</i>	sheepshead minnow
<i>Fundulus</i> spp.	killifish
<i>Gambusia</i> spp.	mosquitofish
<i>Megalops atlanticus</i>	tarpon
<i>Mugil</i> spp.	mullet
<i>Poecilia latipinna</i>	sailfin molly
<i>Strongylura</i> spp.	needlefish
Mollusks	
<i>Busycon contrarium</i>	lightning whelk
<i>Cerithium eburneum</i>	ivory cerith
<i>Isognomon alatus</i>	flat tree oyster
<i>Isognomon radiatus</i>	Lister's tree oyster
<i>Marisa cornuarietis</i>	giant rams horn
<i>Melampus bidentatus</i>	eastern melampus
<i>Melongena corona</i>	Florida crown conch
<i>Tellin</i> spp.	tellin
Crustaceans	
<i>Cardisoma guanhumi</i>	great land crab
<i>Uca</i> spp.	fiddler crab
Submerged Aquatic Vegetation	
<i>Acetabularia</i> spp.	mermaid's wineglass (green algae)
<i>Batophora</i> spp.	green algae
<i>Caulerpa</i> spp.	green algae
<i>Ruppia maritima</i>	widgeon grass
Source: adapted from FPL 2014b	

Other onsite aquatic resources include hypersaline mudflats, remnant canals, channels, dwarf mangrove wetlands, and open water. In June 2009, Tetra Tech NUS, Inc. (Tetra Tech 2009) conducted fish surveys throughout the Turkey Point site in both CCS and non-CCS waters. Sampling locations, which are depicted in Figure 7, included:

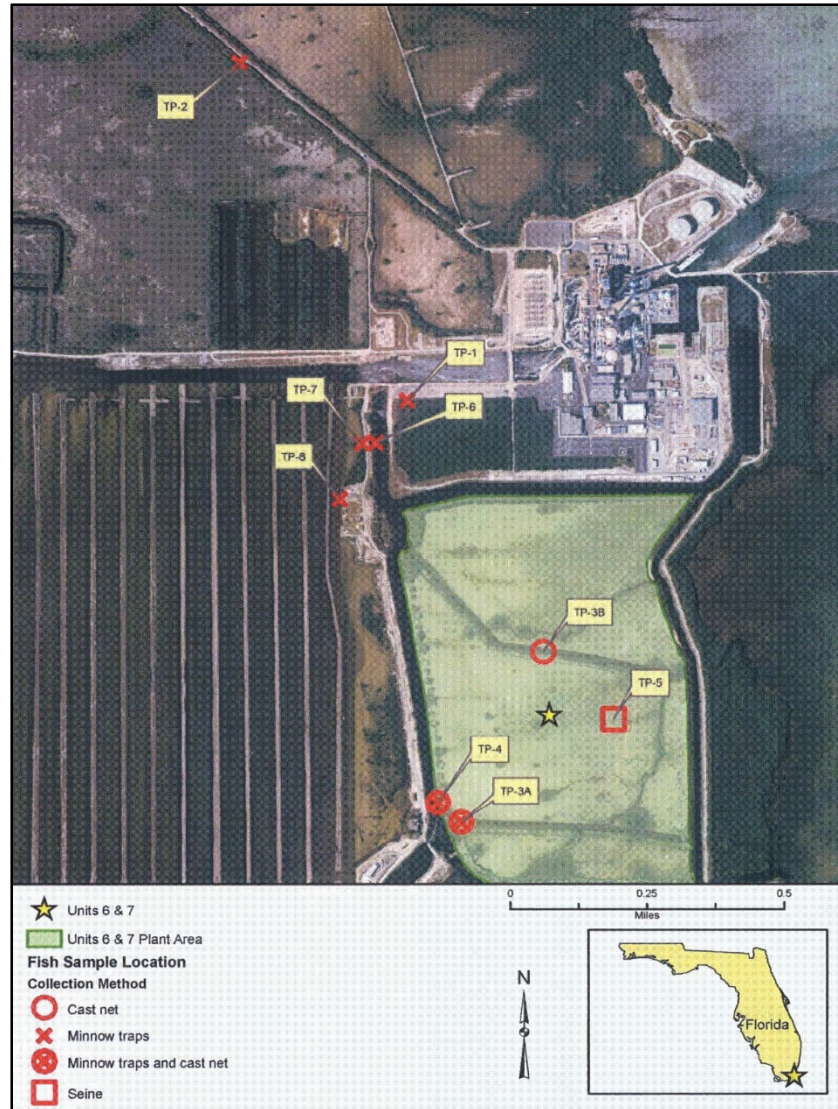
- mangrove wetland west of Turkey Point (TP-1)
- sawgrass marsh/mangrove community adjacent to Palm Drive (TP-2)
- south (TP-3A) and north (TP-3B) remnant canals
- a portion of the return canal (TP-4)
- shallow flats in the east-central part of the Turkey Point plant area (TP-5)
- a dead-end canal (TP-6)
- CCS north (TP-7)
- CCS south (TP-8)

During sampling, water temperatures ranged from 23.9 to 36.5 °C (75.0 to 97.7 °F); salinity was above 50 parts per thousand (ppt) at six sampling stations (TP-3A, TP-4, TP-5, TP-6, TP-7, and TP-8) and less than or equal to 1.5 ppt at two stations in sawgrass/mangrove habitats (TP-1 and TP-2) (Tetra Tech 2009). Tetra Tech biologists collected fish with 8-foot (2.4-m) cast nets, a 20-foot (6-m)-long minnow seine, and standard “Gee” type galvanized minnow traps. Sampling yielded a total of 433 fish representing seven species. All but one of the fish collected were small-bodied, short-lived, schooling species representative of two families: (1) the killifishes (family Cyprinodontidae) and (2) the livebearers (family Poeciliidae). Sheepshead minnow was the dominant species; it was present in seven of the eight sampling stations and represented 63 percent of the collection. Sailfin molly (*Poecilia latipinna*) and goldspotted killifish (*Floridichthys carpio*) were present at the majority of the sampling stations and represented 20.8 percent and 9.9 percent of collections, respectively. No fish were collected at TP-2, a sawgrass marsh/mangrove community adjacent to Palm Drive. All fish were of hardy species common to South Florida. No rare, unusual, sensitive, or protected species were present in collections. **Error! Reference source not found.** identifies the collected species, number collected, and collection locations.

Table 2 Species and Number of Fish Captured at Seven Locations on the Turkey Point Site, June 2009

Species	Common Name	Number Collected	Collection Locations
<i>Cyprinodon variegatus</i>	sheepshead minnow	273	all locations except TP-2
<i>Poecilia latipinna</i>	sailfin molly	90	all locations except TP-2, TP-5
<i>Floridichthys carpio</i>	goldspotted killifish	43	all locations except TP-1, TP-2
<i>Fundulus confluentus</i>	marsh killifish	15	TP-1
<i>Fundulus grandis</i>	gulf killifish	6	TP-1, TP-3, TP-7, TP-8
<i>Gambusia affinis</i>	mosquitofish	5	TP-1, TP-4
<i>Opsanus beta</i>	gulf toadfish	1	TP-4

Source: Tetra Tech 2009



Source: Tetra Tech 2009, Figure 1

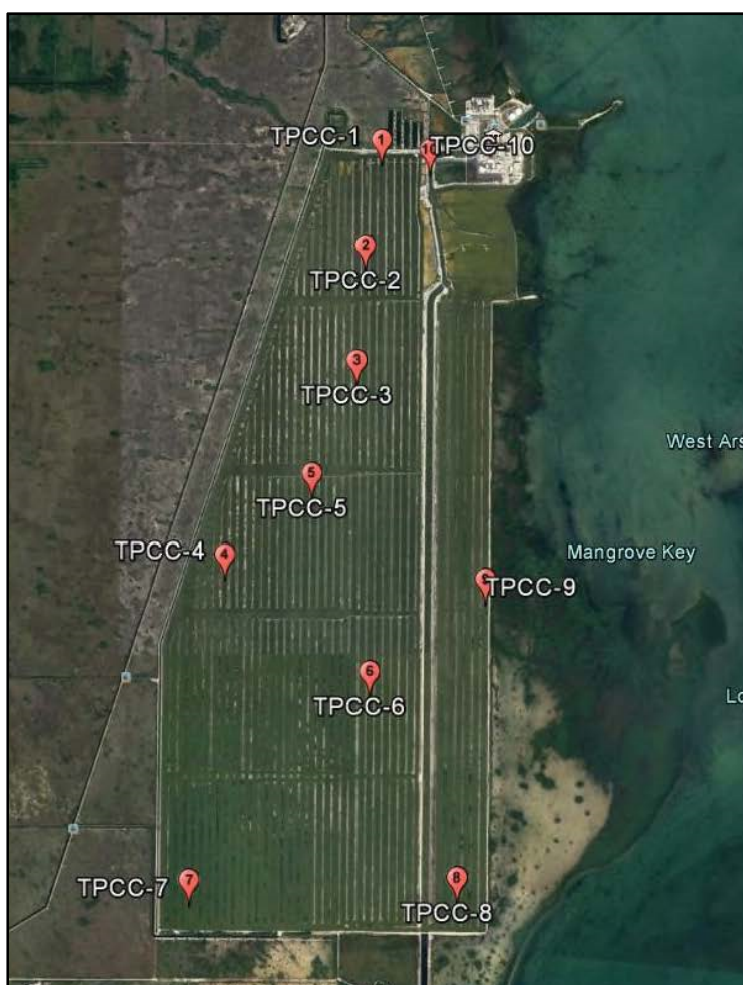
Figure 7 Turkey Point Site Fish Survey Sample Locations, June 2009

Prior to 2010, the CCS environment was of low turbidity and contained low and stable nutrient levels. Widgeon grass (*Ruppia maritima*) covered over 50 percent of the system and were especially prominent in the southern sections of the CCS and in the eastern return canals. Seagrasses underwent annual periods of stress and recovery as CCS salinities cycled between greater than 50 psu (stress) and less than 50 psu (recovery). Despite the harsh environment, seagrass colonies remained relatively stable from year to year (FPL 2016c).

In 2010, the CCS began experiencing a pronounced ecosystem shift. The average salinity of water increased, water quality and clarity began to degrade, and average surface water temperatures increased. Seagrass colonies began to die off due to salinity- and temperature-related stress. By 2012, few seagrass beds remained. The subsequent decomposition of the seagrasses released a significant volume of nutrients into the CCS, and the increased nutrient levels facilitated algae blooms, which resulted in high turbidity and degraded water quality. Algae blooms remained local and isolated in 2011 and 2012. In 2013

and 2014, continuously elevated concentrations of algae were observed throughout the CCS. By 2016, no seagrasses remained in the CCS. The CCS currently operates as an algal-based, phosphorus-limited system such that the algae life cycle primarily dictates the movement of nutrients in and out of the water column. (FPL 2016c, EIA 2017)

To address CCS water quality degradation and as a requirement of the FDEP consent order, in 2016, FPL began implementing its nutrient management plan (FPL 2016c). As part of the consent order, FPL commissioned the Florida-based environmental consulting firm Ecological Associates, Inc. (EAI) in December 2016 to conduct a biological characterization study in the CCS and determine the presence, relative abundance, and distribution of fish, invertebrate, and seagrass populations currently within the system (EAI 2017). EAI chose ten sampling stations within the CCS, each representing different benthic habitats, salinity gradients, and temperature regimes (see Figure 8). Seven of the sampling stations were located in the main CCS area, two were located in return canals, and one was located in a dead-end canal in the northern section of the system. EAI sampled fish and mobile invertebrates, benthic macroinvertebrates, and submerged aquatic vegetation (or seagrass).



Source: EAI 2017, Figure 1

Figure 8 CCS Characterization Survey Sample Locations, December 2016

To identify fish and mobile invertebrates, EAI performed cast net sampling on December 5, 2016, and minnow trap sampling on December 6 and 7, 2016. Cast net sampling targets large mobile organisms throughout the water column, while minnow trap sampling selectively targets small species at the top and bottom of the water column. EAI collected a total of 4,843 individuals. All belonged to one of four taxa: (1) sheepshead minnow, (2) sailfin molly, (3) eastern mosquitofish (*Gambusia holbrooki*), and (4) mudflat fiddler crabs (*Uca rapax*). Cast net samples yielded 282 fish: 252 sheepshead minnow, 22 sailfin molly, and 1 eastern mosquitofish. All fish collected during cast netting were small (less than 45 millimeters (mm) (1.75 inches) standard length). Minnow traps yielded 4,547 fish and 14 crabs: 3,900 sheepshead minnow, 627 sailfin mollies, 20 eastern mosquitofish, and 14 mudflat fiddler crabs. Fish ranged from 10 to 60 mm (0.4 to 2.4 inches) standard length, and crabs ranged from 8 to 11 mm (0.3 to 0.43 inches) carapace length and 11 to 15 mm (0.43 to 0.59 inches) carapace width.

Sheepshead minnow were abundant throughout the CCS and were found at all 10 sampling stations during the characterization study. This species can live and successfully reproduce in high salinity waters (up to 147 psu) and high temperatures (up to 43 °C (109.4 °F)) (Johnson 1974). Sailfin mollies are moderately abundant throughout the system. This species is also able to tolerate high salinities (up to 80 psu), high temperatures (up to 40 °C (104 °F)), and low dissolved oxygen (Fischer and Schlupp 2009; Nordlie et al. 1992; Timmerman and Chapman 2004). Eastern mosquitofish were only found at 2 of the 10 sampling stations and are likely rare in the CCS as a whole. This species can also tolerate hot water (up to 38 °C (100.4 °F)) and hypersaline water (up to 58.8 psu) with low dissolved oxygen (Chervinski 1983; Specziar 2004). Mudflat fiddler crabs were captured incidentally with sampling methods not designed to capture crabs, so EAI did not make any conclusions regarding crab abundance in its CCS characterization study report. Nevertheless, mudflat fiddler crabs have also been documented as able to withstand high-temperature, high-salinity, and low-dissolved oxygen conditions (Costa and Soares-Gomes 2015, Vernberg and Tashian 1959, Zanders and Rojas 1996). Meroplankton sampling would be required to conclusively determine whether mudflat fiddler crabs are actively reproducing in the CCS or whether individuals were immigrating into the system. EAI found no evidence that the environmental conditions within the CCS were negatively affecting the growth or reproduction of the species captured, all of which tended to be heat- and salinity-tolerant species.

To identify benthic macroinvertebrates, EAI collected benthic mini-ponar grabs on December 6, 2016, which the company subsequently processed in a laboratory. A total of 79 individuals of 3 taxa were identified. The polychaete *Capitella capitata* was the most common taxon collected followed by marine oligochaetes (Class Oligochaeta) and midge larvae (Family Chironomidae). EAI calculated benthic macroinvertebrate densities to range from 30 to 489 individuals per square meter at stations with organisms present. Evidence of relic gastropod and bivalve shells were also present at some stations; however, EIA did not collect any live mollusk specimens.

In addition to fish and benthic sampling, EAI used underwater video on December 5 and 6, 2016, along defined video transect surveys to search for living submerged aquatic vegetation (seagrasses). Widgeon grass, which was previously the predominant submerged aquatic vegetation in the CCS, can grow in waters ranging from 64.4 to 86 °F (18 to 30 °C). However, temperatures above 73.4 to 77 °F (23 to 25 °C) have a negative influence on widgeon grass photosynthesis (Arnold et al. 2017). One study on the effect of salinity on widgeon grass determined that 8- to 12-week-old plants could not tolerate salinities above 21,000 parts per million (Mayer and Low 1970). During the CCS characterization study, EAI did not observe any

seagrasses. Because water clarity was poor throughout the entire project area, EAI also scanned its benthic macroinvertebrate collections for living vegetation. No samples contained living vegetation. In its report, EAI attributed the lack of submerged aquatic vegetation to the CCS turbid water conditions, high salinity, and high temperatures.

While differences in sampling methods and effort make it difficult to arrive at definitive conclusions, the available information on the CCS aquatic community indicates that species diversity within the system has declined over time. Submerged aquatic vegetation is no longer present in the system, and a number of the fish species reported as present in the system in 2007 and 2009 were not collected during the 2016 characterization study. The current aquatic community is of low diversity and includes only those species that can withstand hot, hypersaline waters with low dissolved oxygen and poor water clarity.

4.3.3 Biscayne Bay and Card Sound

Biscayne Bay is a shallow subtropical saline lagoon that extends the length of Miami-Dade County. A series of barrier islands belonging to the Florida Keys borders the eastern edge of Biscayne Bay and separates it from the Atlantic Ocean. The mainland forms the western and northern borders of the bay. Connection between Biscayne Bay and the Atlantic Ocean is greatest north of Boca Chita Key (a small island in Biscayne National Park). Ocean access is most restricted in the southern portion of the bay at Card Sound and Barnes Sound due to the presence of Key Largo and its associated barrier islands. The average depth of the bay is approximately 5 feet (1.5 m) at mean lower low water, and its maximum depth is approximately 13 feet (4.0 m). Salinity is highly influenced by rainfall and ranges from 24 to 44 ppt. Annual surface water temperatures range from 59 to 92 °F (15 to 33 °C). The bay's shallow depths and low spring tidal range (0.9 m or 3 foot maximum) result in a vertically well-mixed system with weak stratification.

Within the bay, Biscayne National Park encompasses 173,000 acres (70,000 ha) of water and coastal lands as well as 42 islands. The park is home to a large segment of the Florida reef, the only living coral reef tract in the continental United States. The park supports an array of wildlife, including more than 600 fish species, many of which are commercially and recreationally important, and 21 federally threatened or endangered species. Notably, the bay provides habitat for the following federally listed animal and plant species: the West Indian manatee, the smalltooth sawfish (*Pristis pectinata*), the American crocodile, and Johnson's seagrass (*Halophila johnsonii*) (FDEP 2017a). Johnson's seagrass is the first and only marine plant to be listed as threatened under the ESA.

The Biscayne Bay Aquatic Preserve includes 67,000 acres (27,000 ha) of sovereign submerged lands managed by the FDEP's Office of Coastal and Aquatic Managed Areas. The preserve runs the length of Biscayne Bay from the headwaters of the Oleta River down to Card Sound near Key Largo. The FDEP has designated the waters within the preserve as Outstanding Florida Waters, a designation for waters worthy of special protection because of natural attributes. For waters with this designation, the State of Florida cannot issue permits for direct discharges that would lower ambient water quality (FDEP 2017b).

Card Sound is a shallow bay south of the Turkey Point site. Card Sound has limited connection to the Atlantic Ocean and lies wholly within the boundary of the Florida Keys National Marine Sanctuary. The mangrove forests surrounding Card Sound are part of the longest continuous stretch of mangrove forest remaining on the east coast of Florida and serve as a source of food and refuge for approximately 70 percent of the region's commercially and recreationally

important marine species. Both Biscayne Bay and Card Sound are nursery areas for the spiny lobster (*Panulirus argus*). The State of Florida has designated the area from Cape Florida near Key Biscayne south to Card Sound as the Biscayne Bay-Card Sound Lobster Sanctuary.

Section 2.4.2 of NUREG–2167, “Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7” (NRC 2016), describes Biscayne Bay, Card Sound, and other nearby aquatic resources in detail. The descriptions included in that EIS are incorporated into this biological assessment by reference.

Monitoring in Biscayne Bay

FPL has commissioned ongoing, semiannual ecological monitoring of the Turkey Point site and surrounding environment, including Biscayne Bay, since September 2010 as a requirement of the FDEP’s Conditions of Certification (FDEP 2016b), Condition X, in connection with the Turkey Point 2012 extended power uprate and the SFWMD’s fifth supplemental agreement. An environmental consulting services company named Ecology & Environment, Inc. conducted the most recently reported period of monitoring for Biscayne Bay in September 2016 and May 2017 (one fall and one spring event). Ecology & Environment, Inc. summarized and compared the results of this monitoring period with corresponding past results during the historical period of record. The results appear in the 2017 *Turkey Point Plant Annual Monitoring Report* (E&E 2017). This section briefly summarizes the monitoring methods and the 2016–2017 results.

FPL performs aquatic ecological sampling in three locations adjacent to the CCS within Biscayne Bay and Card Sound (BB1, BB2, and BB3) and one reference site in Barnes Sound (BB4), which lies directly south of Card Sound. Within each of the study areas, ecological conditions are monitored along two 2-km- (1.2-mile-) long shore-parallel transects (designated “a” and “b” for each study area) that lie approximately 250 and 500 m (0.16 and 0.32 miles) from shore. Each transect is divided into eight, 250-m- (0.16-mile-) long segments, and a 1-km² (0.6-mi²) point was randomly selected along each of the eight segments during the initial September 2010 sampling event to be used as the permanent location for all future sampling events. Thus, ecological monitoring encompasses a total of 16 sampling points per study area and a total of 64 sampling points across all study areas. This sampling design is based on FPL’s Florida State-approved monitoring plan.

At each sampling location, FPL surveys and categorizes submerged aquatic vegetation according to the Braun-Blanquet Cover Abundance Index. Sediment depth and general physical and surface water parameters are collected. Turtle grass (*Thalassia testudinum*) blades are collected for laboratory nutrient analysis. In addition to quantitative data, divers also record qualitative characteristics of the benthic conditions surrounding each sampling point.

In the 2017 *Turkey Point Plant Annual Monitoring Report* (E&E 2017), ecological monitoring findings were similar to those reported in previous post-uprate annual monitoring reports. The major findings were as follows.

- The areas with seagrass are representative of the other seagrass communities found along the coastal fringe of South Florida.
- Data collected during the reporting period continue to support the conclusion that the CCS does not have an ecological impact on the surrounding areas.

5.0 Species and Designated Critical Habitat Likely To Be Adversely Affected

This section describes the life history of and the potential impacts to the American crocodile and the eastern indigo snake, the two federally listed species that the proposed action of Turkey Point subsequent license renewal is likely to adversely affect.

5.1 American Crocodile

5.1.1 Life History of the American Crocodile

5.1.1.1 Species Overview

In October 1975, the FWS listed the United States population of the American crocodile as endangered (40 *Federal Register* (FR) 44149). In March 2007, the FWS reclassified the distinct vertebrate population segment of the American crocodile in Florida as threatened (72 FR 13027). American crocodiles are large, green-grey, lizard-shaped reptiles that look similar to alligators. Florida crocodiles can be distinguished from alligators because the Florida crocodile's snout becomes narrower closer to the nose, and when its mouth is closed, the fourth tooth in the lower jaw is exposed. In Florida, adult crocodiles are approximately 4 m (12.5 feet) in length, and tend to be more slender than alligators (71 FR 13027). Miami-Dade County is one of the few places where American crocodiles and alligators both occur.

Crocodiles inhabit coastal areas from southern Florida to the Caribbean and Central America, primarily living in mangrove swamps and along low-energy mangrove-lined bays, creeks, and inland swamps. In Florida, habitat use shifts seasonally whereby adults tend to inhabit areas closer to or on the coastline during the breeding and nesting seasons and then retreat inland to fresh and brackish water swamps, creeks, and bays during the winter. Crocodiles are opportunistic feeders, and consume a variety of fish, snails, crustaceans, crab turtles, snakes, birds, and mammals. Hatchlings, or juveniles, primarily prey upon aquatic invertebrates and fish. (FWS 1999)

Females become reproductively active around 10- to 13-years of age and only nest one time per year. Optimum nesting requirements include the presence of elevated, well-drained substrates near water greater than 1 m (3 feet) deep. Nests are ideally protected from wind and wave action, human disturbances, and predators. The biggest threats to nests and developing eggs including flooding, over-drying, and raccoon predation. In Florida, 33 to 78 percent of American crocodile eggs successfully hatch each year. Soon after hatching, hatchlings leave nest sites for nursery habitats that are generally more sheltered and contain shallower, lower salinity water (between 1 and 20 ppt), and more vegetation cover. Hatchlings can double or triple in size within the first year, depending upon the availability of freshwater and prey. (71 FR 13027)

In 1975, FWS estimated that only 10 to 20 breeding American crocodile females remained in Florida. At that time, primary threats to the species included hunting, habitat modification due to urbanization in South Florida, and a lack of protection for crocodiles and their habitat. Over the subsequent 30 years, the American crocodile populations in South Florida increased substantially. In 2005, FWS estimated an American crocodile population in Florida of between 1,400 to 2,000 adults and juveniles. Similarly, FWS documented just over 90 nests in 2005. The nesting range also increased to both the eastern and western coasts of Florida. By 2007, FWS estimated that the American crocodile population was likely once again occurring

throughout its historical range in South Florida. Although 95 percent of crocodile nesting habitat in Florida is currently protected, FWS noted in its 2007 reclassification rule that the rapid rate of development in South Florida will limit the crocodile population's future expansion and concluded that urban development in South Florida still poses a threat to the full recovery of crocodiles in the State. The FWS also noted in its 2007 reclassification rule that most crocodile nesting habitats are on artificial substrates that require human maintenance. For the continued recovery of the species, FWS determined that these artificial nesting habitats must continue to be maintained or crocodiles need to move into areas with natural substrates for nesting. (71 FR 13027).

5.1.1.2 Critical Habitat

Designated critical habitat for the American crocodile includes land, marine, and nearshore areas from the tip of Turkey Point, eastwards into portions of Biscayne Bay and Card Sound, and southwest towards the southern portions of Everglades National Park and Key Largo (50 CFR 17.95, "Critical Habitat—Fish and Wildlife"). The majority of the action area, including the CCS and the southeastern portion of the Turkey Point site, is designated critical habitat for the American crocodile (see Figure 9, below).

The FWS has not specified physical and biological features for American crocodile designated critical habitat. However, in the FWS's biological opinion for the Turkey Point Unit Nos. 6 and 7 combined licenses, the agency stated that it considers nesting substrate and foraging habitat to be essential features for the species (FWS 2017a).

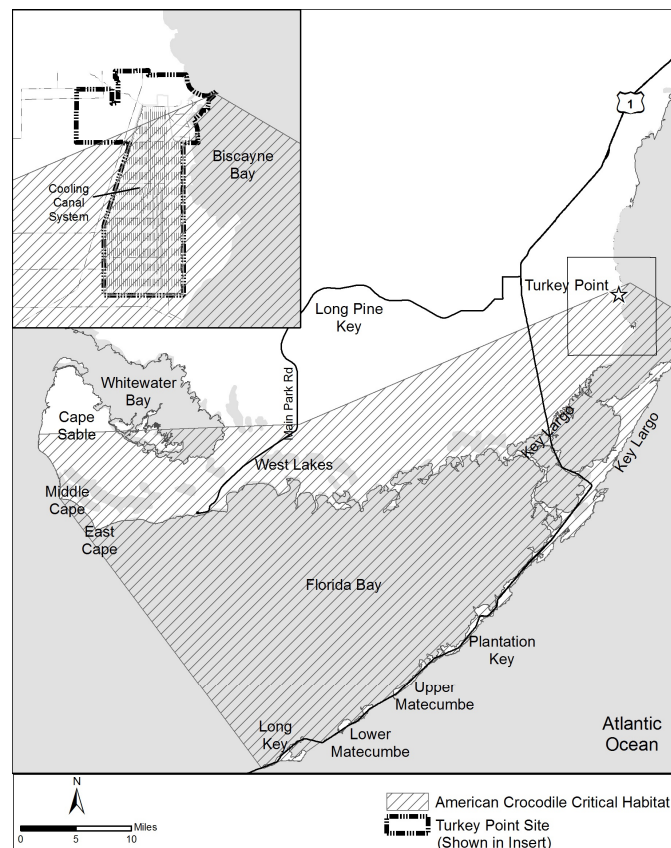


Figure 9 Critical Habitat for the American Crocodile near and on the Turkey Point Site

5.1.1.3 Habitat and Population Trends at Turkey Point

Turkey Point currently supports a relatively large population of American crocodiles and is the second largest breeding aggregation of crocodiles in Florida (71 FR 13027). Construction of the CCS in the 1960s and 1970s created new nesting habitat for crocodiles. Crocodiles were first observed at Turkey Point in 1976, and nesting was first documented in 1978 (FPL 2018c). In FWS's reclassification of the Florida distinct vertebrate population segment of American crocodiles from endangered to threatened in 2007, FWS noted that the Turkey Point site provides an important nesting habitat for this species (71 FR 13027).

The CCS provides nesting, foraging, breeding, and basking habitat for the American crocodile. For example, the raised berms are well suited for nesting because they are well drained, near water, and well protected from human disturbances as the entire CCS is off limits to the public. As described below, within FPL's crocodile management plan, FPL has actively improved nesting habitat by creating and labeling crocodile sanctuaries within the CCS, excluding maintenance workers from nesting areas during the nesting season, removing exotic vegetation, and constructing freshwater ponds for hatchlings (FPL 2018c).

Nesting and Hatchling Surveys

FPL has conducted annual American crocodile nest and hatchling surveys at Turkey Point since the first crocodile nest was discovered in 1978 (FPL 2018b). The current surveys include the following:

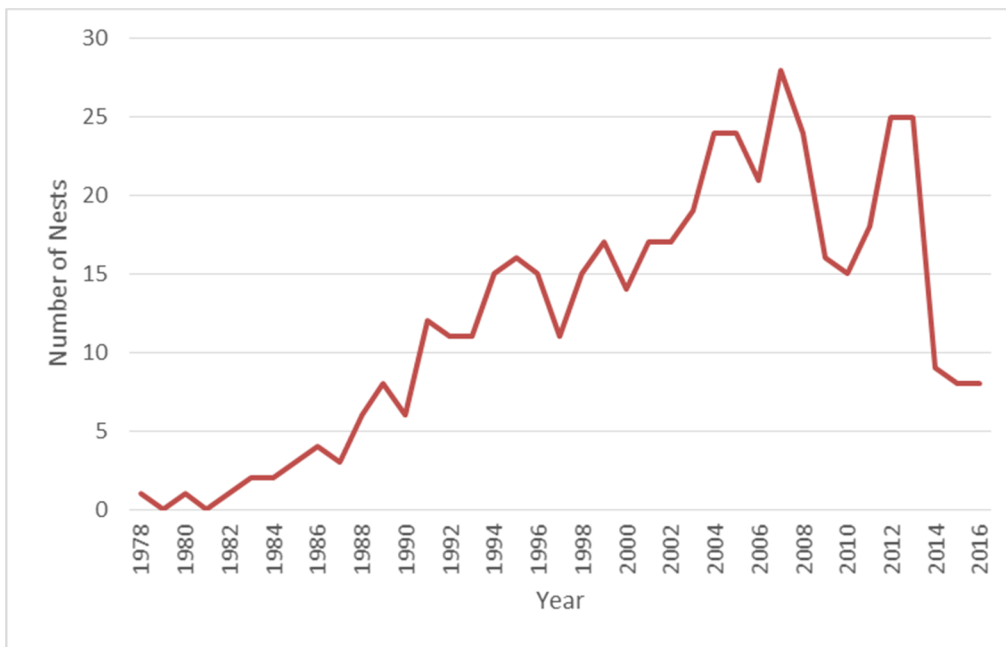
- 1) **Night Surveys:** An airboat survey of nesting hot spots conducted at night from April through mid-August each year. FPL records new nests, female activity, and hatchling activity.
- 2) **Day Surveys:** An airboat survey in the CCS to locate potential nests and monitor adult female visitation of nests, usually conducted early in the morning from April through mid-August each year. The goal is to locate all nest sites, locate hatchlings, and inform FPL's designation of hot spots.
- 3) **Interceptor Ditch Survey:** A truck survey, usually conducted in the early morning, along the interceptor ditch canal to document any crocodiles. Surveys occur once per week year-round.
- 4) **Spatial Distribution Survey:** An airboat survey of the entire CCS over 3 nights conducted by an FPL crocodile specialist and two University of Florida biologists. Surveyors record the size and location of all crocodiles observed.
- 5) **Capture Survey:** Truck and airboat surveys at least three times a year, each survey lasting for 3 days and 3 nights, to capture crocodiles, record body measurements, and gather biometric data.

FPL conducts all surveys in accordance with its ESA Section 10(a)(1)(A) permit (TE092945-2) from the FWS to minimize impacts to crocodiles (FPL 2018b). In addition, the spatial distribution and capture surveys are required by the FDEP's Conditions of Certification (FDEP 2016b), Condition XVII.B.1, and conducted under the University of Florida's ESA Section 10(a)(1)(A) permit. The NRC staff notes that the exact methodology for conducting surveys has been modified since 1978. Additional details regarding nesting and hatchling surveys can be found in FPL's latest annual crocodile monitoring report (2018c), "Turkey Point Plant Annual

American Crocodile (*Crocodylus acutus*) Report,” and FPL’s (2018b) response to requests for additional information (see response to SS-FWS-3 in FPL [2018b]).

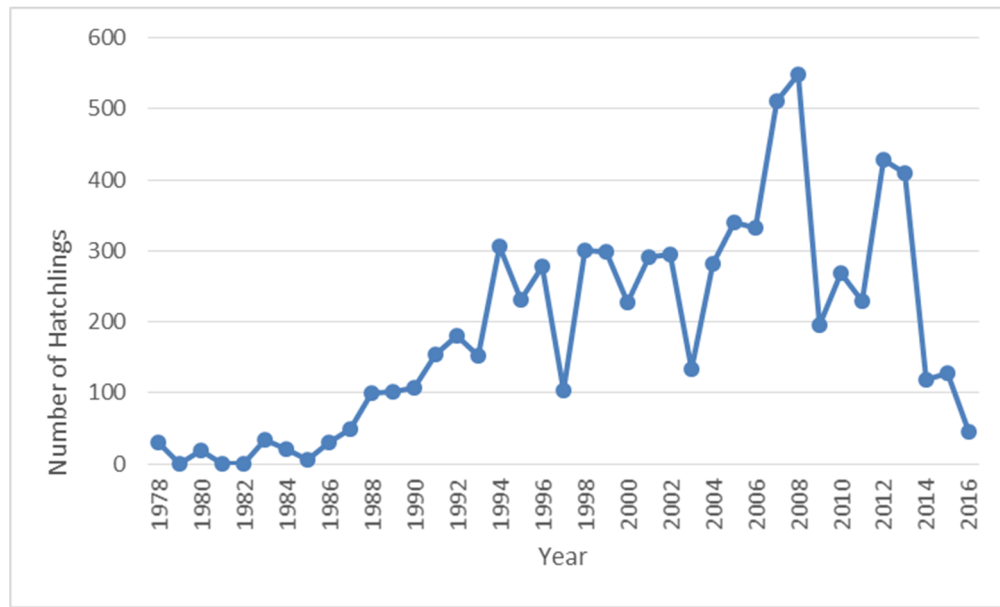
The number of American crocodile nests at Turkey Point steadily increased from 1978 (the year the first nest was found) through the early 2000s (see Figure 10 and Figure 11). For example, FPL documented 1 to 2 nests per year from 1978–1981 and 10 to 15 nests per year from 1990–1995. The number of nests and hatchlings peaked in 2008 and 2009 when FPL documented 28 nests (in 2008) and 548 hatchlings (in 2009). FPL’s crocodile management plan and efforts to improve and create nesting habitat significantly contributed to the increase in the number of nests at Turkey Point, which in 2007, was considered the second largest breeding aggregation in Florida (71 FR 13027).

The number of nests and hatchlings, however, have declined since 2009 (see Figure 10 and Figure 11). FPL (2010a) attributed the initial reduction in observed nests and hatchlings captured in 2010 to the record low temperatures recorded in South Florida during the winter of 2009–2010. The cold winter may have caused a delay in successful courtship interactions or prohibited females from storing enough energy to reproduce. The number of nests and hatchlings increased from 2011–2014. Most recently, the number of nests has rapidly decreased from 25 nests in 2014 to 8 or 9 nests from 2015–2017. Similarly, the number of hatchlings declined from 409 in 2015 to 119, 127, and 46 in 2015, 2016, and 2017, respectively. Section 5.1.2.2, contains additional information and discussion on changes to crocodile nesting and hatchling populations at Turkey Point.



Source: FPL 2018b

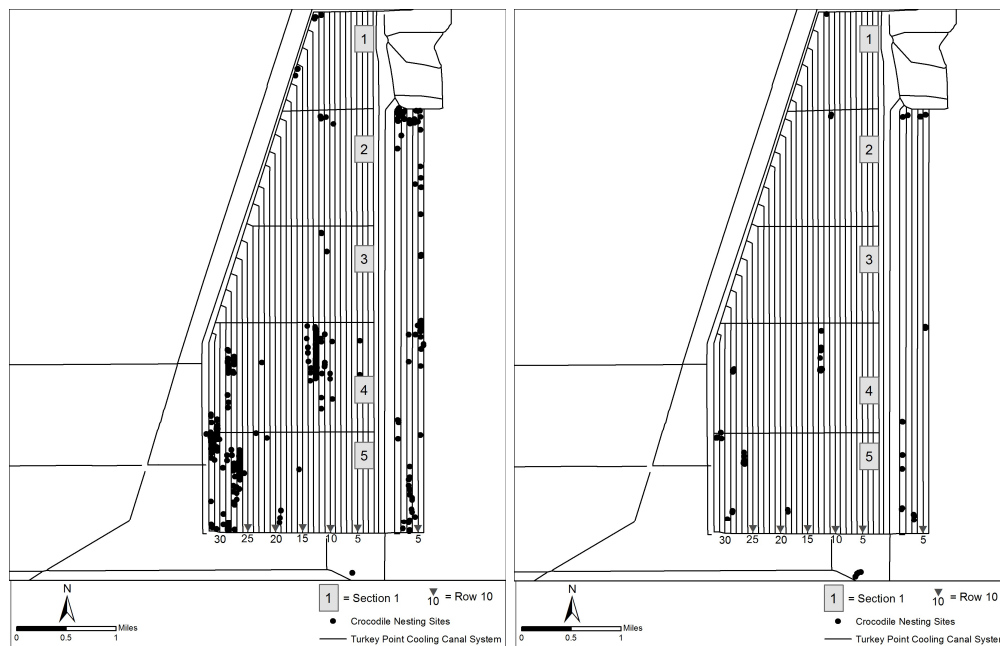
Figure 10 Number of American Crocodile Nests at Turkey Point, 1978–2017



Source: FPL 2018b

Figure 11 Number of American Crocodile Hatchlings at Turkey Point, 1978–2017

FPL (2010b) plotted the crocodile nest locations within the CCS from 1978–2012 (see Figure 12). Nesting locations generally clustered in two locations within the CCS: the southern portions and the northeastern corner. These areas tend to have the lowest water temperatures within the CCS. FPL used this spatial information in part to determine crocodile hot spots for surveys and to determine crocodile sanctuaries that are protected from various operational and maintenance activities as described in the FPL crocodile management plan.



Source: FPL 2010b; NRC 2015

Figure 12 Locations of Crocodile Nests in the Turkey Point Cooling Canal System, 1978–2010 (left) and 2011–2012 (right)

Mazzotti and Cherkiss (2003) compared the nesting success, or proportion of all nests laid that produced at least one hatchling, between 1979 and 1999 at three nesting sites: Turkey Point, Everglades National Park, and North Key Largo. Turkey Point had the highest rate of nesting success (91–100 percent) as compared to 58 percent in Everglades National Park, and 48 percent in North Key Largo. Desiccation, predation, and flooding contributed to the lower success rate in the Everglades National Park. Desiccation was the main threat in North Key Largo. Hatchlings, however, are likely harder to find in Everglades National Park and North Key Largo, which could have artificially reduced the success rate for these two sites (Mazzotti and Cherkiss 2003).

Mazzotti and Cherkiss (2003) also compared hatchling survival and growth rates among the three locations. Diminished growth rates is an important health indicator because it is more difficult for smaller hatchlings to avoid predators and find food. Hatchling survival was highest at North Key Largo, but hatchlings grew slightly faster at Turkey Point. Everglades National Park had the lowest survival and growth rate, likely due to the longer distance hatchlings needed to travel from nesting to nursery habitat. At Turkey Point, FPL staff transport hatchlings from nesting to nursery habitats to increase the chances of hatchling survival (FPL 2018b). The primary risk to hatchlings at Turkey Point is the survival rate once FPL staff move hatchlings offsite to nursery grounds, where the hatchlings develop into juveniles and subadults (Mazzotti and Cherkiss 2003). The survival rate of Turkey Point hatchlings, juveniles, and subadult crocodiles once they are moved offsite to nursery grounds is currently unknown.

FPL Crocodile Management Plan

The current FPL crocodile management plan describes a variety of activities for creating and enhancing crocodile nesting habitat and for monitoring reproductive success, growth, and survival of hatchlings (FPL 2018b). Key elements of the monitoring and habitat protection program include the following:

- Preserving and creating habitat suitable for crocodile nesting and basking
- Establishing exclusion zones at known nesting sites (also referred to as nest sanctuaries)
- Daytime and nighttime monitoring surveys to document crocodile nesting activity and use of the CCS
- Capturing and tagging crocodile hatchlings using American Veterinary Identification Devices microchip technology
- Relocation of hatchlings to low-salinity (nursery) habitat during early life stages to increase survival
- Recapture, monitoring, and release of individuals to document growth and survival
- Removal of exotic plant species, particularly Brazilian pepper (*Schinus terebinthifolius*) and Australian pine (*Casuarina equisetifolia*)

In addition, the FPL crocodile management plan contains measures to protect crocodiles from human disturbances during operational and maintenance activities, including the following:

- Constraints on vehicular traffic within the CCS at night and during critical periods of the nesting season

- Constraints on road maintenance and construction activities at night, during critical periods of the nesting season, and within known crocodile crossing sites
- Identification and avoidance of nest sanctuaries
- Training requirements for site personnel handling hatchlings and using equipment in the area

FPL also created and implemented a crocodile awareness program to educate the public concerning the status of the American crocodile in South Florida.

Many of these activities are in accordance with FWS's (1999) "South Florida Multi-Species Recovery Plan," as described below in Section 5.1.2.7." Furthermore, in reclassifying the Florida distinct vertebrate population segment from endangered to threatened in March 2007, the FWS acknowledged that FPL's activities to create nesting habitat, monitor crocodile populations, and minimize disturbances during operations contributed to increases in nests, hatchlings, and the adult population of crocodiles in Florida (71 FR 13027). The NRC staff notes that FPL (2018b) intends to continue to implement its crocodile management plan through the period of extended operations even though several portions of the plan are not required by any Federal, State, or local agency or agreement.

5.1.2 Impacts to the American Crocodile and Designated Critical Habitat

Continued operation of Turkey Point would result in many of the same impacts that crocodiles in the action area currently experience given that operational and maintenance activities would remain similar during the remainder of the current and during the period of extended operations (FPL 2018b). The NRC identified six potential effects associated with the proposed action:

- (1) mortality and injuries from vehicular collisions
- (2) reduced nests and hatchling survival
- (3) crocodile health trends and body condition
- (4) impacts to wetland habitats
- (5) human disturbances
- (6) exposure to radionuclides and other contaminants

In section 6.4, "Impact Common to All Species," the NRC staff also analyzed potential impacts from radiological exposures and ground disturbing activities to American crocodiles and the other species included within this Biological Assessment. The NRC staff also analyzed impacts to designated critical habitat for the American crocodile and discusses beneficial impacts to both the American crocodile and its designated critical habitat based on FPL's crocodile management plan and other activities.

5.1.2.1 Vehicular Collisions

Vehicular collisions have been the primary human-induced source of adult crocodile mortality in South Florida from 1971 through 2007 (Mazzotti and Cherkiss 2003; 71 FR 13027). At Turkey Point, vehicular collisions are also a main source of human-induced mortality for crocodiles.

From December 2005 through September 2018, FPL reported six vehicular collisions that resulted in mortality:

- December 21, 2005 (NRC 2006a)
- May 27, 2006 (NRC 2006b)
- September 25, 2008 (FPL 2008)
- November 18, 2011 (FPL 2012b; FPL 2018a)
- September 12, 2012 (FPL 2012c)
- July 28, 2016 (FPL 2016d)

These incidents account for the majority of the reported causal takes at Turkey Point. The majority of these vehicular collisions occur when Turkey Point operational, security, or maintenance staff are driving and inadvertently run over a crocodile that is on the road to bask in the sun or a crocodile that is traveling across the road.

In its 2006 biological opinion, the FWS initially anticipated an incidental take of one American crocodile every 5 years in the form of accidental direct mortality associated with a vehicular collision (FWS 2006a). On August 1, 2006, the FWS amended the biological opinion because its incidental take limit due to vehicular collision was exceeded on May 27, 2006 (NRC 2006b). The revised incidental take limit allows an incidental take of two American crocodiles between May 2006 through May 2011, and one American crocodile per year thereafter (FWS 2006b). FPL has not exceeded its incidental take limit since August 2006.

FPL's biological opinion requires the following reasonable and prudent measures to minimize the risk of takes from vehicular collision:

- Post four speed limit signs labeled as "Speed Limit 5 MPH" along Bechtel Road, where vehicle collisions have previously occurred.
- Provide an informational bulletin on the American crocodile to all Turkey Point employees once every 6 months that includes information about the onsite population, photographs of crocodiles, and descriptions of hatchlings. The bulletin should also remind employees to observe speed limits at all times, to avoid interacting with crocodiles in any way, and to contact their supervisor if a crocodile is observed on or near a road.
- Present information about the onsite crocodile population twice per year at mandatory employee meetings. Presentations should be made during the crocodile mating and nesting season, which is when the onsite crocodile activity is greatest. The presentation should include information similar to that described above for the information bulletin.
- Notify the FWS and the Florida Fish and Wildlife Conservation Commission (FFWCC) upon locating a dead or injured crocodile.

In addition to these requirements, FPL's crocodile management plan also includes several restrictions to minimize the risk of vehicular collisions, especially during the breeding and nesting seasons. For example, FPL restricts vehicular traffic within the CCS at night, during critical periods of the nesting season, and within known crocodile crossing sites. These reasonable and prudent measures, along with the crocodile management plan, follow many of the recommendations within FWS's (1999) crocodile recovery plan for South Florida. The NRC staff notes that FPL (2018b) intends to continue to implement its crocodile management plan

through the period of extended operations even though several portions of the plan are not required by any Federal, State, or local agency or agreement.

Given that FPL must implement any reasonable and prudent measures included in its ITS and that vehicular traffic from Turkey Point Unit Nos. 3 and 4 will remain similar during the period of extended operations, the NRC expects a similar level of vehicular collisions, which has been slightly less than one mortality every 2 years since 2005.

5.1.2.2 Reduced Nests and Hatchling Survival

Crocodile hatchlings require freshwater for proper development and are sensitive to increases in salinity (FWS 1999). Although American crocodiles have salt glands that excrete excess salt and physiological mechanisms to reduce water loss (Mazzotti 1989), hatchlings require low salinity water at least once per week to maintain an osmotic balance (or proper internal salt levels). Moler (1991) determined that during periods of low rainfall, when salinity increases within brackish waters, hatchlings do not gain weight and are less likely to survive during winter months. Based on this information, the FWS (1999) determined that the availability of freshwater is essential to crocodile hatchling survival.

As described above in Section 5.1.1.3, the number of nests and hatchlings at Turkey Point steadily increased from the 1970s through the early 2000s (see Figure 10 and Figure 11). The FWS attributed this population growth to FPL's efforts to improve and create nesting habitat (71 FR 13027). The number of nests and hatchlings at Turkey Point peaked in 2008 and 2009 at 28 nests and 548 hatchlings, respectively, but have since declined. Most recently, the number of nests within the CCS rapidly decreased from 25 nests in 2014 to 8 or 9 nests from 2015 through 2017 (FPL 2018b). Similarly, the number of hatchlings declined from 409 in 2015 to 119, 127, and 46 in 2015, 2016, and 2017, respectively (FPL 2018b). Mazzotti (2015) noted that the number of nests and hatchlings in the CCS declined concomitantly with a decrease in the number of crocodiles observed within the CCS during spotlight surveys.

The FWS (2017a) determined that the most recent reduction in crocodile nesting and hatchling abundance was the result of the increase in water temperature and salinity, and the decrease in water quality in the CCS from 2013 through 2017. During this time period, the temperature increased by 4 °C (7 °F) during certain times of the year, salinity increased to over 90 ppt during certain parts of the year, and an outbreak of cyanobacteria (blue-green algae) greatly increased turbidity. FWS (2017) noted that the cause of these changes is unclear and likely due to multiple factors. For example, FWS (2017) attributed the changes in water quality parameters to FPL's 2014 increase in power production from Turkey Point Unit Nos. 3 and 4, the discharge of vegetative cuttings within the CCS, and/or the lower-than-average precipitation in the area.

FPL (2018b) also noted a decline in the number of nests and hatchlings from 2015 through 2017. In its crocodile monitoring report for 2015, FPL (2016e) stated that the total number of hatchlings has fluctuated over the past 30 years due to changing environmental conditions. FPL (2016e) suggested that the lower number of hatchlings may be due in part to females moving hatchlings to hidden burrows, raccoon predation, or infertile clutches. In its most recent crocodile monitoring report, FPL (2018c) attributed the decline in hatchlings in part to difficulty in locating nests because crocodiles have been nesting in new areas, such as the interceptor ditch canal. FPL (2016e, 2017c, 2018c) also noted that the CCS experienced high salinity and algae levels during those years, and that rainfall, or increasing the amount of water into the system, was the quickest way to reduce salinity and temperature within the CCS.

FPL (2018b) also noted that while no mitigation is currently required for the decline in the number of nests and hatchlings, FPL has been taking actions to reduce the temperature and salinity within the CCS. These actions are required as part of its consent agreement with the DERM and its consent order with the FDEP, described above in Section 4.3.2.1. Future monitoring data will help determine whether the required freshening activities restore the CCS to a level that previously supported the relatively high nesting activity and hatchling abundance documented prior to 2009. FPL (2018b) expects that nesting crocodiles and hatchlings will respond positively to improved habitat conditions from the freshening activities.

In addition to the freshening activities, FPL's crocodile management plan includes several activities that enhance and improve nesting habitat and help provide freshwater for hatchlings. For example, FPL creates freshwater ponds within nesting sites on the CCS and within the Everglades Mitigation Bank. Following the 2011 ESA, Section 7 consultation related to the Turkey Point Unit Nos. 3 and 4 extended power uprate, FPL excavated three additional freshwater ponds on existing CCS berms in the southwest portion of the system to provide additional sources of freshwater for crocodiles. In addition, FPL staff move hatchlings from the CCS to areas of fresher water to help increase the chances of survival. These activities resulted in beneficial impacts to crocodiles. The NRC staff notes that FPL (2018b) intends to continue to implement its crocodile management plan through the period of extended operations even though several portions of the plan are not required by any Federal, State, or local agency or agreement, as further discussed below in Section 5.1.2.7.

Separate from FPL's operation of Turkey Point Unit Nos. 3 and 4, several other facilities either previously used the CCS or currently use the CCS as a source of cooling water. In 2016, FPL retired Turkey Point Unit No. 1, which was a fossil-fueled plant that previously used the CCS as a source of cooling water. FPL also retired Turkey Point Unit No. 2 by 2016. The retirement of Unit Nos. 1 and 2 should have decreased the amount of heat being discharged into the CCS. Turkey Point Unit No. 5, a natural-gas fired plant, continues to use the CCS as a source of cooling water and currently discharges heated water to the CCS.

In summary, the number of American crocodile nests and hatchlings at Turkey Point steadily increased from 1978 through the early 2000s in large part due to FPL's efforts to improve and create nesting habitat onsite. However, since 2009, the number of nests and hatchlings have substantially declined. The FWS (2017a) determined that the most recent reduction in crocodile nesting and hatchling abundance was the result of increased water temperature and salinity and decreased water quality in the CCS from 2013 through 2017. The FWS (2017a) attributed the changes in water quality parameters to multiple factors, including FPL's 2014 increase in power production from Turkey Point Unit Nos. 3 and 4, the discharge of vegetative cuttings within the CCS, and/or the lower-than-average precipitation in the area. FPL (2018b) also acknowledged the decline in the number of nests and hatchlings from 2015 through 2017, and is conducting several activities to improve water quality within the CCS and to continue to protect and improve crocodile nesting habitat.

Based on hatchling requirements for freshwater and the decline in the CCS water quality, the NRC staff concludes that the current conditions within the CCS are having an adverse impact on American crocodile nesting and hatchling success. During the proposed period of extended operations, FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions will likely lead to a growth in the number of nests and hatchlings at Turkey Point. FPL currently conducts, and intends to continue to conduct during the proposed period of extended operations, several

activities that are part of its crocodile management plan that substantially benefit crocodiles, as discussed below in Section 5.1.2.7. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. In conclusion, the NRC staff finds that the current conditions within the CCS are having an adverse impact on American crocodiles, and that this impact will likely be decreased as a result of the consent order and consent agreement to freshen the CCS. The CCS will likely provide more favorable nesting habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

5.1.2.3 Crocodile Health Trends

Crocodiles typically inhabit fresh and brackish waters, but may also inhabit hypersaline habitats, especially during periods of drought. For example, crocodiles larger than 200 grams (g) (7 ounces) have sufficient mass to withstand osmoregulatory stress demands during temporary droughts (Mazzotti and Dunson 1984). Prolonged exposure to hypersaline waters, however, can lead to physiological stress for crocodiles. In such cases, crocodiles may either remain within the lower quality habitat, which could result in dehydration and starvation if prey are also affected, or move to wetlands or mangroves with lower salinity water.

Within the action area, the hypersaline condition of the CCS has been a consistent condition over the past several years. For example, the salinity within the CCS was similar to the salinity in Biscayne Bay, approximately 34 psu, in the 1970s (FPL 2018a). By the 2000s, the salinity within the CCS was twice the average concentration of seawater, 60 psu (FPL 2018a). From 2013 through 2017, the salinity increased to 90 ppt at certain times of the year, generally following periods of low rainfall (Squires et al. 2018).

In addition to the potential effects from dehydration from the high-salinity waters, the degradation of the CCS may also have led to lower prey availability. Adult crocodiles consume a wide variety of prey, although some reports suggest that fish is a primary food source (FWS 1980). Within aquatic habitats, crocodiles forage within seagrass beds (UF undated b). At Turkey Point, no studies have been conducted to determine the diets of crocodiles. However, the availability of certain fish species and seagrass foraging habitats declined rapidly or disappeared completely from the CCS following the hypersaline, warm conditions beginning with the warm conditions in the early 2010s.

As described in Section 4.3.2 above, the CCS went through a pronounced ecosystem shift from a seagrass-dominated system to an algal-dominated ecosystem. The loss of seagrass and increase in nutrients, turbidity, salinity, temperature, and algae limited the number of fish species that could likely tolerate such conditions. For example, in 2007, FPL (2014b) reported eight species to occur in the CCS. By 2016, however, EAI (2017) collected only the following four species from the CCS:

- sheepshead minnow
- sailfin molly
- eastern mosquitofish
- mudflat fiddler crabs

Previous to this 2016 survey, a number of fish, mollusks, crabs, and submerged aquatic vegetation were also observed or recorded as occurring in the CCS, as described above in

Section 4.3.2. These species have either been eliminated from the CCS or persist in such low numbers that they were not collected during the 2016 survey. Submerged aquatic vegetation was determined to be completely absent from the CCS at the time of the 2016 survey, and EAI (2017) stated in its report that temperature-related stress was one of the factors that contributed to the die-off of the seagrass beds. The NRC staff acknowledges EAI's conclusion regarding seagrass and recognizes that thermal discharges associated with Turkey Point have contributed not only to the disappearance of seagrass within the CCS but to the decline of fish and other aquatic biota and the observed shift towards more heat-tolerant species in recent years.

The FDEP required FPL to perform health surveys before and after the Turkey Point extended power uprate as described in FDEP's (2016b) Conditions of Certification, Condition XVII.B.1. The most recent survey indicated that crocodiles within the CCS are exposed to prolonged stress, as evidenced by higher levels of cortisol (corticosterone) from 2009–2016. During this period, Turkey Point crocodile cortisol levels were elevated compared to crocodiles captured in other parts of Everglades National Park (Squires et al. 2017). During 2015, Squires et al. (2017) determined that starvation likely contributed to the observed higher physiological stress levels for crocodiles inhabiting in the CCS. In addition, in 2015 and 2016, elevated sodium, chloride, total protein, and hematocrit (i.e., red blood cell percentage) levels suggested that crocodiles in the CCS were dehydrated (Squires et al. 2017).

Squires et al. (2017) calculated Fulton's K, which is a quantitative estimate of body condition that takes into account a crocodile's nutritional condition. **Error! Reference source not found.** shows the relationship between the Fulton's K measure of crocodile body condition and salinity levels in the CCS between 2009 and 2016. Squires et al. (2017) conducted a statistical analysis to examine the relationship between body condition and various environmental conditions. The study determined that water temperature did not have a significant effect on body condition, but that maximum air temperature and maximum salinity negatively affected body condition for crocodiles. These results suggest that the hypersaline water within the CCS is having an adverse impact on the health of crocodiles within the CCS.

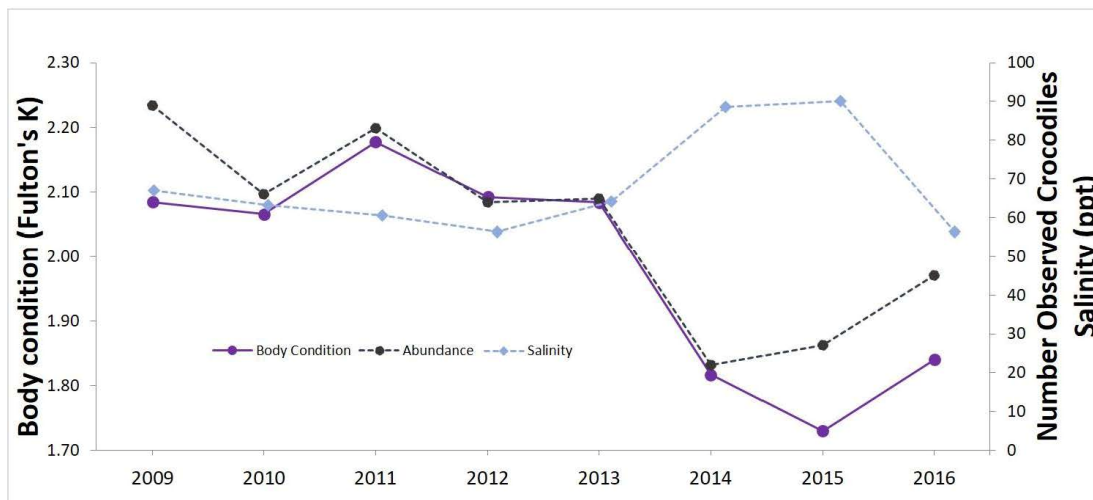


Figure 13 Fulton's K (Measure of Crocodile Body Condition) and Abundance of American Crocodiles Captured at Turkey Point between 2009 and 2014 in Relation to Salinity

Squires et al. (2017) noted that 2016 was the first year of increased body condition and observed crocodile numbers since the decline began in 2013. These results suggest that some crocodiles may have shifted their habitat use and moved out of the CCS into surrounding wetlands and mangroves. In addition, as the conditions within the CCS improve based on the freshening activities required by FPL's consent order with the FDEP, more crocodiles may return to the CCS.

The FDEP did not require health surveys beyond 2015. In 2016, the FWS requested that surveys be conducted for another 3 to 5 years. FPL agreed to conduct an additional health study in 2017 (FPL 2017d) and again in 2018 (FPL 2018e). As of September 2018, FPL has not agreed to any future surveys.

Based on the above, the NRC staff finds it reasonable to assume that conditions within the CCS will continue to improve given that Turkey Point Unit Nos. 1 and 2 retired in 2016 and no longer discharge heated water into the CCS and because FPL is required to decrease the salinity in the CCS, develop a nutrient management plan for the CCS, and restore seagrass in portions of the CCS based on its current Nutrient Management Plan required as part of its consent agreement with the DERM and its consent order with the FDEP (see Section 4.3.2.1). In addition, Squires et al. (2017) predicts that crocodile health will continue to improve as the CCS becomes less physiologically stressful and aquatic prey levels increase as a result of the freshening activities required by FPL's consent order with the FDEP. Nonetheless, some uncertainty exists regarding the future quality of crocodile foraging habitat within the CCS once the terms of the consent agreement and consent order are achieved. For example, seagrass restoration is not required throughout the entire CCS and seagrass may not naturally repopulate large portions of the CCS even if water quality improves due to the complex and specific environmental conditions seagrass require to grow. In addition, given that the CCS does not have a direct surface water connection with any waterbodies, any species that was previously extirpated from the CCS would not be able to independently migrate into and repopulate within the CCS.

In summary, the number of American crocodiles at Turkey Point steadily increased from the 1970s through the early 2000s in large part due to FPL's efforts to protect, create, and improve habitat for this species. However, the body condition for crocodiles substantially declined from 2013 to 2015, and Squires et al. (2017) determined that the maximum air temperature and maximum salinity within the CCS negatively affects body condition for crocodiles. Squires et al. (2017) also determined that, during this time period, crocodiles within the CCS exhibited higher physiological stress levels than crocodiles in the surrounding areas, likely due to starvation and dehydration.

Based on the significantly higher physiological stress for crocodiles in the CCS and the significant relationship between salinity and crocodile body condition, the NRC staff concludes that the current conditions within the CCS are having an adverse impact on crocodiles. During the proposed period of extended operations, the retirement of Turkey Point Unit Nos. 1 and 2 and FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions within the CCS will likely decrease the physiological stress for crocodiles, help some prey species increase in abundance within the CCS, and may allow for more crocodiles to reinhabit the CCS. FPL currently conducts, and intends to continue to conduct during the proposed period of extended operations, several activities that are part of its crocodile management plan that substantially benefit crocodiles, as discussed below in Section 5.1.2.7. The NRC staff notes that not all

portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. In conclusion, the NRC staff finds that the current conditions within the CCS are having an adverse impact on American crocodiles nests and hatchlings, and that this impact will likely decrease as a result of the consent order and consent agreement that require FPL to freshen the CCS. The CCS will likely provide more favorable foraging habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

5.1.2.4 Impacts to Wetlands Habitats

Anthropogenic changes in the amount and timing of freshwater flow to South Florida substantially influences the health and species composition of estuarine and freshwater wetlands in South Florida. The FWS (1999) determined that although no direct causal relationship exists between freshwater flow alterations and changes in the size of the American crocodile population, some of the population decline through the 1970s can likely be attributed to changes in the amount and timing of surface water flow to South Florida. The FWS (1999) also concluded that when added to all other natural and anthropogenic sources of mortality, wetland habitat degradation could have substantial impacts on crocodile nesting and hatchling survival.

While the continued operation of Turkey Point would not result in any direct wetland loss or habitat fragmentation, indirect impacts to wetland habitat could occur due to the hypersaline plume associated with the CCS, dewatering activities, and site runoff. In association with its site certification from the State of Florida for its the most recent extended power uprate, FPL developed a vegetative monitoring plan to survey plots of freshwater marsh and mangrove habitat immediately adjacent as well as further from the CCS. The results of these surveys are summarized in Section 4.3.1, above. As noted in Section 4.3.1, for both sawgrass height and live biomass, the reference transect (T6) exhibited similar growth patterns as the transects closer to the CCS (T1-4). These growth patterns suggest that large, landscape-scale environmental factors, such as the hydroperiod or overall water depth, affect changes in sawgrass growth more so than the distance from the CCS. In addition, the fluctuations in sawgrass height and live biomass over time suggest that there is a high degree of natural variability influenced by multiple environmental parameters. Given that FPL's ecological monitoring study does not indicate that operation of the CCS is having measurable impacts on adjacent wetland habitat, the NRC staff does not expect that the proposed action would alter the quality of nearby wetlands habitat in any measurable way.

In 2017, the SFWMD issued Permit No. 13-06251-W for FPL to recover and extract hypersaline water within and around the CCS (SFWMD 2017). The use of dewatering wells has the potential to impact wetland growth because vegetative growth and species composition is directly related to water depth and the hydroperiod (UF undated a; Foti et al. 2012). As part of the permitting process, the SFWMD (2017) modeled drought conditions (up to a 1-in-10 drought) and determined that a maximum drawdown of less than 0.3 feet (9.1 centimeters (cm)) could occur west and north of the CCS under drought conditions during operation of the wells. This includes both onsite and offsite wetlands that are west of the CCS. The SFWMD determined that the L-31E Canal would provide some buffering of the drawdown area due to canal storage. In conclusion, the SFWMD (2017) stated that the authorized withdrawal would impact wetlands; however, the impacts to onsite and offsite wetlands would be minimal. Minor degradation of freshwater wetlands or mangroves would result in insignificant impacts to the American crocodile because the relative amount of affected wetlands that could experience

minor degradation would be a very small portion of the available wetlands within the action area and adjacent to the action area. Based on the minimal impacts to a small proportion of the wetlands adjacent to the CCS, the NRC staff does not expect that the dewatering activities would adversely alter the quality of nearby crocodile foraging habitat.

Runoff of contaminants, sediments, herbicides, and oils to onsite and offsite wetlands could also degrade this important habitat. Stormwater runoff from impervious surfaces can change the frequency or duration of inundation and soil infiltration within wetlands, mangroves, and neighboring terrestrial habitats. Effects may include erosion, altered hydrology, sedimentation, and other changes to plant community characteristics. Such impacts would be minimized at Turkey Point since FPL uses a stormwater conveyance system, which collects stormwater and minimizes the amount of excess runoff that wetland habitats outside the CCS receive. In addition, FDEP regulations require a stormwater permit and stormwater pollution prevention (SWPP) plan for any land disturbing maintenance activities. FPL's SWPP plan identifies potential sources of pollutants that could affect stormwater discharges and describes the best management practices that FPL uses to reduce pollutants in stormwater discharges to ensure compliance with applicable conditions of the permit (FPL 2018b). Best management practices include soil stabilization, such as seeding and structural controls (e.g., silt fences). FPL has also developed a spill prevention control and countermeasures plan that identifies and describes the procedures, materials, equipment, and facilities it uses to minimize the frequency and severity of oil spills (FPL 2018a). Collectively, these measures ensure that the effects to wetland habitats would be minimal during the current and proposed license renewal terms.

Given that these impacts would result in minor if any changes to wetland habitats, the NRC staff determined that continued operations would have an insignificant impact on the vegetative community or other prey resources for the American crocodile within freshwater wetlands or mangroves. As such, wetlands within the action area would continue to provide foraging habitat for the American crocodile. SFWMD's modeling studies suggest that dewatering could degrade wetlands, SWFMB determined that such degradation would be minor and limited to a small portion of the available wetland habitat. Therefore, such activity would result in insignificant impacts to the American crocodile because the relative amount of affected wetlands that could experience minor degradation would be a very small portion of the available wetlands within the action area and adjacent to the action area. If wetlands are degraded to a degree that and cause a decline in habitat quality, American crocodiles could find other adequate wetland foraging habitat nearby. Therefore, the NRC staff finds that the proposed action would not adversely impact foraging activity for the American crocodile.

5.1.2.5 Human Disturbances

Human disturbances can negatively impact crocodiles, especially during the nesting period. Kushlan and Mazzotti (1989) suggested that repeated close human presence may cause female crocodiles to abandon nests or relocate nest sites. At Turkey Point, human disturbance is limited to plant workers because the public cannot enter the site. In its species recovery plan, the FWS (1999) determined that human exclusion may be the best management technique for protecting crocodiles. Similarly, when reclassifying the species from endangered to threatened, the FWS noted that Turkey Point is closed to public access, a condition which helps to protect crocodiles (71 FR 13027).

Crocodiles are occasionally impinged within the Turkey Point intake system. To remove crocodiles that are trapped within the intake or other onsite structures, Turkey Point personnel follow the guidelines within FPL's crocodile management plan, which includes securing any live

crocodiles and releasing them within suitable habitat. This activity is currently covered under the ESA Section 10(a)(1)(A) scientific research permit associated with FPL's crocodile monitoring (TE092945-2).

Operational activities, such as herbicide treatment, vegetative trimming and mowing, removals of invasive species, and infrastructure maintenance, could result in limited disturbance or displacement of crocodiles. However, most of these activities occur within developed portions of the site that do not provide suitable habitat for crocodiles and where crocodiles are unlikely to occur. In addition, crocodiles at Turkey Point are likely acclimated to some amount of human activity because industrial activity has occurred on the site since crocodiles began using the CCS as habitat. Noise levels and human activity during the proposed period of extended operations would remain similar to the noise levels and human activity that crocodiles are exposed to during current operations. As such, they would not likely cause any additional disturbances that would push crocodiles to avoid or abandon habitat within the action area. In addition, FPL's crocodile management plan lists several measures to reduce disturbances to crocodiles, especially during the nesting season, including:

- constraints on vehicular traffic within the CCS at night and during critical periods of the nesting season
- constraints on road maintenance and construction activities at night, during critical periods of the nesting season, and within known crocodile crossing sites
- identification and avoidance of nest site sanctuaries
- prohibitions on the removal of invasive species in or around active American crocodile nest sites from March to August every year
- training requirements for site personnel that handle hatchlings and use equipment in the area
- human disturbance is limited to workers due to restricted public access

The NRC staff notes that FPL (2018b) intends to continue to implement its crocodile management plan through the period of extended operations even though several portions of the plan are not required by any Federal, State, or local agency or agreement.

Based on the above, the NRC staff does not expect continued operations to adversely impact crocodiles with respect to human disturbances.

5.1.2.6 Designated Critical Habitat

The FWS defines destruction or adverse modification of designated critical habitat as follows:

a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features. (50 CFR 402.02)

As described above in Section 5.1.1.2, the FWS has not specified physical and biological features for American crocodile designated critical habitat. However, in the FWS's biological opinion for the Turkey Point Unit Nos. 6 and 7 combined licenses, the agency stated that it

considers nesting substrate and foraging habitat to be essential features for the species (FWS 2017a).

Nesting substrate

Nesting substrate within the action area includes raised berms within the CCS. Maintenance activities could result in some ground disturbance to critical habitat that provides nesting substrate. Such activities would include hand and mechanical vegetative control, hand and mechanical debris removal, maintenance of the CCS access roads (e.g., mechanical scrapping and aggregate placement), underground piping repair (e.g., digging and equipment staging), and equipment replacement at groundwater wells and monitoring stations. These activities could degrade the quality of nesting habitat by removing or crushing native vegetation. In addition, equipment could compact soil or create depressions, which would make it more difficult for crocodiles to prepare and dig nests. However, the amount of nesting habitat that would be impacted by the proposed action would be a small percentage of the available nesting habitat within the action area. In addition, FPL's environmental control program, crocodile management plan, and the CCS berm maintenance procedures, which FPL intends to continue during the period of extended operations, would minimize the majority of impacts, as described below.

FPL follows, and intends to continue to follow during the period of extended operations, its environmental control program for maintenance activities or other ground disturbing activities that could result in land clearing or excavation, or could result in other activities which would alter the physical environment or ecology of the site. The procedures direct FPL personnel to obtain appropriate local, State, or Federal permits (or some combination of the three) prior to beginning work; familiarize themselves with existing permit and procedural requirements to protect ecological resources; implement best management practices to protect wetlands, natural heritage areas, and sensitive ecosystems; and consult the appropriate agencies, such as FWS, wherever Federal or State-listed species may be affected. In addition, the procedures include environmental review questions and checklists that screen activities for compliance with current requirements and identify activities that would cause environmental impacts, such as disturbances to natural areas or impacts to wetlands.

FPL's (2018b) crocodile management program also includes procedures to minimize impacts to nesting habitat within the action area. For example, FPL constrains road maintenance and construction activities at night, during critical periods of the nesting season, and within known crocodile crossing sites at and near nesting locations.

FPL's (2018b) CCS berm maintenance procedures would also avoid or minimize impacts from maintenance activities within designated critical habitat, especially during the nesting season. For example, FPL prohibits work in or around active American crocodile nests sites from March through August. Furthermore, the procedures also state that any ground disturbing work within crocodile sanctuaries or critical habitat will avoid creating depressions or compacting the soil on berms, which could inhibit a crocodile's ability to dig to prepare its nesting site. Lastly, FPL requires the onsite crocodile program biologist to review and approve any work within crocodile sanctuary or critical habitat, and such work is conducted by trained staff.

In addition to minimizing impacts, many of FPL's procedures would result in beneficial impacts to nesting habitats during the remainder of the current license and were the operation of Turkey Point Unit Nos. 3 and 4 extended from 2032 and 2033 to 2052 and 2053, respectively. As part of FPL's crocodile management plan, FPL creates and preserves nesting habitat within the

action area. In addition, FPL surveys areas within the action area to locate nest sites, labels the areas as crocodile sanctuaries, and restricts certain operation activities within crocodile sanctuaries to reduce human disturbances during nesting season. FPL also removes non-native species within the CCS berms as part of its maintenance procedures. Within crocodile sanctuaries, FPL maintains native vegetation after removing non-native species. In addition, FPL creates freshwater ponds within nesting sites on the CCS and within the Everglades Mitigation Bank. Following the 2011 ESA Section 7 consultation for the extended power uprate, FPL excavated three additional freshwater ponds on existing CCS berms in the southwest portion of the system to provide additional sources of freshwater for crocodiles. Lastly, nesting habitat within the Turkey Point site is protected from human disturbances because Turkey Point is not open to the public (FPL 2018b).

The NRC staff finds that although the continued operations Turkey Point Unit Nos. 3 and 4 may result in minor disturbances within nesting habitat, these impacts would not diminish the value of critical habitat for the conservation of the species based upon the following:

- the small percentage of available nesting habitat that would be impacted
- FPL's environmental control program, crocodile management plan, and the CCS berm maintenance procedures that would minimize and avoid certain impacts
- FPL's crocodile management program, which creates, improves, and preserves nesting habitat for the American crocodile

Foraging habitat

Foraging habitat within the action area includes freshwater wetlands, mangroves, and the CCS. As described above in Section 5.1.2.4, the NRC staff examined potential impacts to wetlands from the hypersaline plume associated with the CCS, dewatering activities, and site runoff. The NRC staff determined that impacts to wetlands would be minimal based on FPL's wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan. Given that any impacts would be minimal and localized, the NRC staff finds that these impacts would not diminish the value of critical wetland habitat for the conservation of the species.

As described above in Section 5.1.2.3, "Adult Crocodile Health Trends," the NRC staff examined changes to foraging habitat within the CCS. Crocodile foraging habitat within the CCS has significantly changed due to an increase in water salinity, temperature, and nutrient levels from 2009 through 2015. For example, in the 1970s, the salinity within the CCS was similar to the salinity in Biscayne Bay, approximately 34 psu (FPL 2018a). By the 2000s, the salinity within the CCS was twice the average concentration of seawater at 60 psu (FPL 2018a). From 2013 through 2017, the salinity increased to 90 ppt at certain times of the year, generally following periods of low rainfall (Squires et al. 2018). FWS (2017a) attributed the increase in salinity to the operation of Unit Nos. 3 and 4, the discharge of vegetative cuttings within the CCS, and the lower than average precipitation in the area. Following the increases in salinity, temperature, and nutrient levels, the CCS went through a pronounced ecosystem shift and the number of fish species and density of fish rapidly decreased (EIA 2017). In addition, EAI (2017) determined that seagrass, a foraging habitat for the American crocodile, no longer occurs within the CCS.

The NRC staff also reviewed crocodile monitoring studies to determine how the loss of seagrass habitat and lower availability of prey within the CCS may be affecting the American crocodile.

As described above in Section 5.1.2.2 and Section 5.1.2.3, recent crocodile monitoring data suggest that the number of nests and hatchlings in the CCS has significantly decreased during the period of time that the salinity increased. In addition, Squires et al. (2017) found a significant relationship between the maximum salinity level within in the CCS and lower body condition for crocodiles. Squires et al. (2017) also documented higher levels of starvation and dehydration for crocodiles inhabiting the CCS than that expected for a healthy crocodile population. Based on the significantly higher physiological stress for crocodiles in the CCS and the significant relationship between salinity and crocodile body condition, the NRC staff finds that the current conditions within the CCS are having an adverse impact on crocodiles.

FPL is currently conducting several required activities to mitigate habitat degradation within the CCS based on its consent agreement with the DERM and its consent order with the FDEP, as described above in Section 4.3.2. The NRC staff finds it reasonable to assume that water quality within the CCS will continue to improve given that Turkey Point Unit Nos. 1 and 2 were retired by 2016 and that FPL is required to decrease the salinity in the CCS, develop a nutrient management plan for the CCS, and restore seagrass within portions of the CCS based on its consent agreement with the DERM and its consent order with the FDEP. In addition, Squires et al. (2017) predicts that crocodile health will continue to improve as the CCS becomes less physiologically stressful and aquatic prey levels and diversity increase as a result of the freshening activities.

The NRC staff finds that continued operations would diminish the value of critical habitat for the conservation of the species with respect to foraging in the CCS. Based upon the above information, the NRC staff finds that the current conditions within the CCS are diminishing the value of critical habitat in the CCS for American crocodiles. The operation of Turkey Point Unit Nos. 3 and 4 is contributing to changes in the CCS water quality (e.g. flow within the CCS), along with several other important environmental factors (e.g. rainfall, decomposition of vegetation within the CCS). During the proposed period of extended operations, FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions within the CCS will likely increase the value of designated critical habitat within the CCS. FPL currently conducts, and intends to continue to conduct during the proposed period of extended operations, several activities that are part of its crocodile management plan that substantially improve critical habitat, as discussed below in Section 5.1.2.7. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. In conclusion, the NRC staff finds that the current conditions within the CCS are diminishing the value of designated critical habitat within the CCS, and that the value of this critical habitat will likely increase as a result of the consent order and consent agreement that require FPL to freshen the CCS. Thus, the CCS will likely provide more favorable habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

5.1.2.7 Beneficial Impacts to American Crocodile and Designated Critical Habitat

FPL has implemented a crocodile management plan for several decades at the Turkey Point site (see summary in Section 5.1.3, FPL 2018b). The crocodile management plan has resulted in significant, beneficial impacts to the American crocodile population and its designated critical habitat. For example, in reclassifying the species from endangered to threatened in March 2007, the FWS acknowledged that FPL's activities to create nesting habitat, monitor

crocodile populations, and minimize disturbances during operations contributed to the substantial increases in nests, hatchlings, and adult population of crocodiles in Florida (71 FR 13027). Furthermore, many of FPL's activities are in accordance with the FWS's (1999) "South Florida Multi-Species Recovery Plan," for the American crocodile. FPL's beneficial activities that are also included in FWS's (1999) "South Florida Multi-Species Recovery Plan," for the American crocodile include:

Monitoring

- Monitor to determine the current number, distribution, and size class trends of crocodiles
- Conduct or continue mark-recapture efforts, population and nest surveys, and habitat surveys

Habitat Enhancement and Protection

- Protect nesting, basking, and nursery habitat of American crocodiles
- Continue to maintain nesting sites adequate to maintain viability of the American crocodile
- Restore areas to suitable habitat
- Create additional nesting habitat for crocodiles in South Florida
- Remove exotic species

Activities to Minimize Human and Habitat Disturbances

- Protect and enhance existing colonies of American crocodiles
- Control human-induced crocodile mortality and disturbance
- Alert motorists on roads where repeated collisions between automobiles and American crocodiles have occurred
- Restrict the public from the Turkey Point site

Public Outreach

- Inform employees and the public about the recovery needs of crocodiles

FPL (2018b) stated that it will continue to implement its crocodile management plan during the remainder of the current license and throughout the proposed period of extended operations. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. FPL is required to implement the terms and conditions within its incidental take statement, as described above in Section 5.1.2.1, and is required to continue to freshen and improve habitat within the CCS by its consent agreement with the DERM and its consent order with the FDEP. As explained previously, the NRC staff finds that, moving forward, as well as into the proposed period of extended operations, these activities will have substantial beneficial impacts on the American crocodile and will likely decrease the current impacts to crocodiles from degraded water quality within the CCS.

5.1.2.8 Conclusion

At Turkey Point, vehicular collisions are a main source of human-induced mortality for adult crocodiles. From December 2011 through September 2018, FPL reported six vehicular strikes that resulted in crocodile mortality. Given that operational activities related to operating Turkey Point Unit Nos. 3 and 4 will remain similar during the proposed period of extended operations,

vehicular collision rates will likely continue at a similar rate. Thus, the NRC staff concludes that vehicular collisions associated with the proposed action may adversely affect the American crocodile.

For the past several decades, FPL has implemented a crocodile management plan at the Turkey Point site that has resulted in significant, beneficial impacts to the American crocodile and its designated critical habitat. In reclassifying the species from endangered to threatened in March 2007, the FWS acknowledged that FPL's activities to create nesting habitat, monitor crocodile populations, and minimize disturbances during operations contributed to the substantial increases in nests, hatchlings, and adult population of crocodiles in Florida (71 FR 13027). More recently, however, the body condition for crocodiles has substantially declined from 2013 to 2015, and nest and hatchling abundance has also decreased. Squires et al. (2017) determined that the maximum air temperature and maximum salinity within the CCS negatively affected body condition for crocodiles. Squires et al. (2017) also concluded that crocodiles within the CCS exhibited higher physiological stress levels than crocodiles within the surrounding areas, likely due to starvation and dehydration. Based on the significantly higher physiological stress for crocodiles in the CCS, the significant relationship between salinity and crocodile body condition, and the reduction in nest and hatchling abundance, the NRC staff finds that the current conditions within the CCS are having an adverse impact on crocodiles. The operation of Turkey Point Unit Nos. 3 and 4 is contributing to changes in the CCS water quality (e.g. flow within the CCS), along with several other important environmental factors (e.g. rainfall, decomposition of vegetation within the CCS).

During the proposed period of extended operations, FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions will likely decrease the physiological stress for crocodiles, improve nesting habitat, and allow for more crocodiles to reinhabit the CCS. Additionally, FPL (2018b) intends to continue to implement its crocodile management plan during the remainder of the current licensing period and throughout the period of extended operations, which the NRC staff expects will continue to result in substantial beneficial impacts to the American crocodile. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. FPL is required to implement the terms and conditions within its incidental take statement, as described above in Section 5.2.1. In conclusion, the NRC staff finds that the current conditions within the CCS are having an adverse impact on American crocodiles nests, hatchlings, and body condition, and that these impacts will likely decrease as a result of the consent order and consent agreement that require FPL to freshen the CCS. The CCS will likely provide more favorable nesting and foraging habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

Finally, the NRC staff determined that potential impacts to wetland habitats, potential impacts from human disturbances (excluding activities covered under ESA Section 10(a)(1)(A) scientific research permit associated with FPL's crocodile monitoring (TE092945-2)), potential impacts from exposure to radionuclides (see Section 6.4), and potential impacts from ground disturbing activities (see Section 6.4) are not likely to adversely affect the American crocodile because these impacts would be insignificant or discountable.

5.2 Eastern Indigo Snake

5.2.1 Life History of the Eastern Indigo Snake

The FWS listed the eastern indigo snake (*Drymarchon corais couperi*) as federally threatened in January 1978 (43 FR 4026). This large, black, nonvenomous snake can grow up to 265 cm (8.7 feet). Eastern indigo snakes prefer upland habitats, but in South Florida it will also inhabit freshwater marshes, canal banks, mangroves, pinelands, tropical hardwood hammocks, and human-altered habitats (FWS 1999, 2008). This species requires a mosaic of habitats to complete its annual cycle and seeks underground refugia to stay warm and hide from predators (FWS 2008). Prey include any vertebrates small enough to be physically overtaken by eastern indigo snakes, including fish, frogs, toads, snakes, lizards, turtles, turtle eggs, juvenile gopher tortoises, small alligators, and birds.

The Orianne Society, a nonprofit reptile and amphibian conservation group, conducted eastern indigo snake surveys in 2013, 2014, and 2016 within the action area and immediately adjacent to the action area within the Everglades Mitigation Bank (Orianne Society 2013, 2016). The Orianne Society captured two eastern indigo snakes in 2013, two in 2014, and four in 2016. The Orianne Society noted that captured snakes tended to occur along roads near mixed vegetation, poisonwood (trees), Australian pine trees, or mangroves. Within the action area, the Orianne Society and FPL (2018b) observed snakes along the south access road, on roads near the CCS, and in areas near the meteorological tower. In FPL's "American Crocodile Monitoring Report – 2000," the applicant stated that it would conduct weekly surveys during fall, winter, and early spring months in order to monitor eastern indigo snakes (FPL 2000). Although the NRC staff requested a copy of these survey results in a request for additional information, FPL (2018b) could not provide a copy because it said that these survey results are no longer available. In the NRC's 2002 supplemental environmental impact statement (SEIS) for the Turkey Point Unit Nos. 3 and 4 initial license renewal, the NRC staff (2002a) stated that the eastern indigo snake has been observed on the Turkey Point site. This information suggests that this species has occurred in the action area for several decades.

5.2.2 Impacts to the Eastern Indigo Snake

The federally listed eastern indigo snake occurs within the action area, especially in the southern portions of the CCS. Potential impacts from continued operations on this threatened species include vehicular collisions, habitat and human disturbances, and degradation of wetland habitats. In section 6.4, the NRC staff also analyzed potential impacts from radiological exposures and ground disturbing activities to the eastern indigo snake and the other species included within this Biological Assessment.

5.2.2.1 Vehicular Collisions

The FWS (2017a) stated that vehicular collisions may be a significant source of indigo snake injury and mortality. At Turkey Point, the greatest risk to eastern indigo snakes is likely due to vehicular collisions. In 2007, FPL reported a dead eastern indigo snake onsite. The FPL staff were using heavy equipment to clear exotic vegetation within a crocodile sanctuary in the Everglades Mitigation Bank when they discovered the dead snake below the rootball of removed brush (FPL 2018f). In its report, FPL determined that the cause of death was due to the use of heavy equipment. FPL contacted the Florida Fish and Wildlife Department and collected the carcass to be shipped to the Fish and Wildlife Department (NRC 2007). FPL also contacted the FWS (FPL 2018f). The NRC staff is not aware of any other incidents or reports

since 2007. During the proposed period of extended operations, Turkey Point Unit Nos. 3 and 4 activity levels will remain approximately the same as for current operations (FPL 2018b).

FPL currently conducts several activities to minimize the potential for vehicle collisions with eastern indigo snake. For example, FPL currently conducts employee training for eastern indigo snake awareness and posts signs around construction zones that contain pictures and descriptions of the snake, warnings against disturbing the snake, and contact information for reporting a sighting of the eastern indigo snake (FPL 2018b). FPL (2018b) stated that it will continue these activities during the proposed period of extended operations. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements.

During a 2013 onsite survey of Turkey Point, the Orianne Society observed many eastern indigo snakes in roadways, especially along the Turkey Point south access road. The Orianne Society also noted that Turkey Point personnel noticed the snakes on the roadways and stopped their vehicles to prevent any injury or harassment to the snakes (Orianne Society 2013).

Given that a substantial population of eastern indigo snakes occur on the Turkey Point site, that snakes use the roadways within the action area for basking or moving between habitats, and that a snake was killed by an FPL vehicle in 2007 conducting an activity (e.g., removal of exotic vegetation) that will occur during the remainder of the current license and during the proposed period of extended operations, the NRC staff finds it possible that a future vehicular collision could occur between Turkey Point vehicles and an eastern indigo snake.

5.2.2.2 Human Disturbances

As described above in Section 5.1.2.5, human disturbances at Turkey Point are limited to workers because FPL does not allow the public to freely access the site. Operational activities—such as herbicide treatment, vegetative trimming and mowing, and infrastructure maintenance—could disturb or displace the eastern indigo snake. However, most of these activities occur within the developed portion of the site, which is not the portion of the site with suitable snake habitat. Noise and human activity levels during the proposed period of extended operations would remain similar to those levels during the current operations and are thus unlikely to cause the snake to avoid or abandon habitat within the action area. In addition, indigo snakes at Turkey Point are likely acclimated to some amount of human activity because industrial activity has occurred on site for several decades. Therefore, the NRC staff finds that human disturbances during continued operation of Turkey Point Unit Nos. 3 and 4, such as disturbances from maintenance and infrastructure repair activities, would result in insignificant or discountable effects to the eastern indigo snake.

5.2.2.3 Impacts to Wetland Habitat

Indirect impacts to wetland habitat could occur due to the hypersaline plume associated with the CCS, dewatering activities, and site runoff. However, as discussed above in Section 5.1.2.4, the NRC staff finds that impacts to wetlands would be minimal based on FPL's wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan. Given that these impacts would result in minor if any changes to wetland habitats, the NRC staff determined that continued operations would have an insignificant impact on the vegetative community or other prey resources for the eastern indigo snake. As such, wetlands within the action area would

continue to provide foraging habitat for the eastern indigo snake and continued operation of Turkey Point Unit Nos. 3 and 4 would not adversely impact foraging activity for this species.

5.2.2.4 Conclusion

The NRC staff finds that continued operation of Turkey Point Unit Nos. 3 and 4 could result in adverse impacts to the eastern indigo snake because a substantial population of eastern indigo snakes occur on the Turkey Point site, snakes use the roadways within the action area for basking or moving between habitats, and in 2007, a snake was killed by an FPL vehicle that was conducting an activity (e.g., removal of exotic vegetation) that will occur during the remainder of the current license and during the proposed period of extended operations. Therefore, the NRC staff finds it possible that a future vehicular collision could occur between Turkey Point vehicles and an eastern indigo snake.

The NRC staff notes that FPL currently conducts, and intends to continue to conduct during the period of extended operations, activities to minimize the potential for a vehicular collision, such as conducting employee training for eastern indigo snake awareness and posting signs around construction zones that contain pictures and descriptions of the snake, warnings against disturbing the snake, and contact information for reporting a sighting of the eastern indigo snake.

The NRC staff determined that potential impacts to wetland habitats, potential impacts from human disturbances, potential impacts from exposure to radionuclides (see Section 6.4), and potential impacts from ground disturbing activities (see Section 6.4) are not likely to adversely affect the eastern indigo snake because these impacts would be insignificant or discountable.

6.0 Species Not Likely To Be Adversely Affected

In addition to the American crocodile and the eastern indigo snake, the NRC staff identified 13 species that are federally listed as either threatened or endangered and that may occur within the action area (Table 3). The NRC staff identified these 13 plant and animal species by first using the FWS's online Information for Planning and Conservation (IPaC) tool, understanding the habitat requirements for each species, referring to FPL's published observations of federally listed onsite species, and researching other relevant biological surveys. As noted in Table 3, designated critical habitat for the West Indian manatee occurs within the action area. Designated critical habitat does not occur within the action area for any other species listed in Table 3.

Table 3 The 13 Federally Listed Threatened or Endangered Species That May Occur at or near the Action Area

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status ^(a)
Birds			
<i>Caladris rufa</i>	red knot	Suitable habitat (mudflats, salt marshes, and mangroves) occur onsite (FWS 2017a); Observed onsite (FPL 2014b).	Threatened
<i>Charadrius melodus</i>	piping plover	Suitable wintering habitat occurs onsite and within the vicinity, such as at beaches, mudflats, and sandflats (FPL 2014b; FPL 2018a); however, there are no documented occurrences on site (FPL 2014b; NRC 2015).	Threatened
<i>Mycteria americana</i>	wood stork	Suitable foraging, resting, and roosting habitat within the CCS and onsite wetlands; Regularly observed onsite (NRC 2015; EAI 2017; FPL 2018b).	Threatened
<i>Rostrhamus sociabilis</i>	Everglade snail kite	Suitable habitat (lowland freshwater marshes) occurs at and near Turkey Point (NRC 2015); Observed within the Everglades Mitigation Bank adjacent to Turkey Point (FPL 2014b).	Endangered
<i>Setophaga kirtlandi</i>	Kirtland's warbler	Suitable habitat (dense mangroves) occurs at and near Turkey Point; No known observations onsite (NRC 2016; FPL 2018a).	Endangered
Mammals			
<i>Eumops floridanus</i>	Florida bonneted bat	Suitable roosting (e.g., palm trees) and foraging habitat occurs at Turkey Point (FWS 2017a); Observed within the vicinity of Turkey Point (FPL 2018a).	Endangered
<i>Puma concolor coryi</i>	Florida panther	Florida Panther focus area occurs in the vicinity of Turkey Point (FWS 1999); Observed 2 miles west of Turkey Point (SFWM 2013).	Endangered
<i>Trichechus manatus</i>	West Indian manatee	Designated critical habitat occurs adjacent to Turkey Point; Observed in the vicinity of Turkey Point including in nearby freshwater canals and nearshore seagrass beds in Biscayne Bay (FPL 2012b).	Threatened
Plants			
<i>Argythamnia blodgettii</i>	Blodgett's silverbush	Limited suitable habitat (coastal berms) may occur onsite; Observed within the vicinity of Turkey Point (FPL 2011; Gann et al. 2018).	Threatened
<i>Chromolaena frustrata</i>	Cape Sable thoroughwort	Limited suitable habitat (coastal rock barrens) may occur at Turkey Point; Generally, this species does not occur in disturbed areas (FWS 2010; FPL 2018a; NRC 2016).	Endangered
<i>Consolea corallicola</i>	Florida semaphore cactus	Limited suitable habitat (coastal berms) may occur at Turkey Point (78 FR 63796; NRC 2016); No known occurrences at Turkey Point (NRC 2016; FPL 2018a).	Endangered

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status ^(a)
<i>Linum arenicola</i>	sand flax	Potential to occur onsite given that this species grows less than 1 mile from Turkey Point and suitable habitat (i.e., pine rocklands, marl prairie, and adjacent disturbed areas) occurs within the vicinity (FPL 2018a); however, there are no known occurrences at Turkey Point.	Endangered
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	Suitable habitat (rockland hammocks, sinkhole habitats, and tree trunks that are in deep shade) occur within the vicinity and onsite (Gann et al. 2018; NRC 2016); however, there are no known occurrences of this species onsite (FPL 2018a).	Endangered

(a) “Endangered” means Federally listed as endangered and “threatened” means Federally listed as threatened by either the Fish and Wildlife Service or the National Marine Fisheries Service under 50 CFR Part 17, “Endangered and Threatened Wildlife and Plants,” which implements the Endangered Species Act of 1973.
Source: FWS 2018a

6.1 **Birds**

6.1.1 **Life Histories**

6.1.1.1 Rufa Red Knot

The FWS listed the rufa red knot (*Calidris canutus rufa*) as threatened on December 11, 2014 (79 FR 73706). This migratory shorebird is similar in size to a robin and grows to approximately 9 inches (23 cm) in length with a 20-inch (50-cm) wingspan. Red knots nest and breed within the Canadian Arctic from June through mid-July, at which point the females begin migration while the males stay to tend to the chicks. Approximately a month after the females have gone, the red knot males begin migration. Lastly, the juveniles begin their first migration (FWS 2015). Many rufa red knots migrate more than 9,000 miles (14,000 km) from breeding grounds in the Canadian Arctic to wintering regions in the southeastern United States, northeastern Gulf of Mexico, northern Brazil, and the southern tip of South America (FWS 2015). In Florida, red knots may stop along spring and fall migration routes to forage in sandy beaches, mangroves, and brackish lagoons. Similar habitats may also provide wintering grounds for some individuals. FWS (2015) noted that red knots in Florida inhabit artificial structures such as docks, piers, jetties, causeways, and construction barriers. Prey primarily includes hard-shelled mollusks; however, red knots will also consume softer invertebrates such as worms (FWS 2015). Based on wintering surveys from 1993–1994, Sprandel et al. (1997) identified the top 60 sites for wintering shorebirds in Florida. The closest of these sites to the action area included four sites within the Everglades. However, Sprandel et al. (2000) did not identify any important sites for wintering shorebirds along the Atlantic coast of Miami-Dade County. Primary wintering habitat occurs along the central Gulf Coast.

Within the action area, a red knot was observed in March 2009 near the CCS (FPL 2018a). Mangroves, mudflats, and beach habitat along the east border of the Turkey Point site may provide suitable habitat for wintering or foraging red knots. Red knots may also temporarily rest on artificial structures on the coastline within the action area. In the FWS’s biological opinion for

the Turkey Point Unit Nos. 6 and 7 combined licenses, the FWS (2017) determined that habitats occurring within Miami-Dade County do not appear to be highly valuable to rufa red knots and individuals would not be expected to occur frequently or in large numbers at Turkey Point. Therefore, while a limited number of rufa red knots may temporarily use habitat within the action area, the action area does not include any important wintering grounds for this bird species.

6.1.1.2 Piping Plover

The FWS listed the Atlantic coast population of the piping plover (*Charadrius melodus*) as threatened in December 1985 (50 FR 50726). This plover is a small migratory shorebird that breeds in three geographic regions of North America (FWS 1999). Piping plovers from all three geographic regions migrate to Florida and remain there from late summer through late spring (FWS 1999). Wintering and foraging habitats include beaches, mudflats, and sandflats as well as barrier island beaches and spoil islands (islands made of accumulated dredged soil from construction). Piping plovers tend to prefer foraging and roosting habitat within close proximity of each other. This species forages in small groups and preys upon marine, freshwater, and terrestrial invertebrates (FWS 1999). From 2001 to 2009, the total number of piping plovers observed along the Atlantic coast of South Florida ranged between 15 to 67 individuals (Elliot-Smith et al. 2009). Wintering piping plovers were observed at Crandon Park in Miami-Dade County (Elliot-Smith et al. 2009).

While FPL (2018a) has never observed piping plovers onsite at Turkey Point, the NRC staff (2015) determined that suitable habitat (i.e., mudflats) does occur onsite. In its biological opinion for the Turkey Point Unit Nos. 6 and 7 combined licenses, the FWS (2017) determined that piping plovers are unlikely to occur at Turkey Point.

6.1.1.3 Wood Stork

The FWS originally listed the wood stork (*Mycteria americana*) as endangered in 1984 but then reclassified the species as threatened in 2014 (79 FR 37077). This large, long-legged wading bird has a head-to-tail body length of 85 to 115 cm (33 to 45 inches) and a wingspan of 150 to 165 cm (59 to 65 inches). Wood storks breed in South Florida, including in Miami-Dade County. Nesting, roosting, and foraging habitats include a variety of freshwater and estuarine habitats (FWS 1999). The wood stork's ideal nesting habitat includes medium-to-tall trees in swamps or on islands surrounded by relatively broad expanses of open water. In South Florida, the majority of breeding colonies occur in large stands of bald cypress (*Taxodium distichum*) and red mangrove. As wading birds, wood storks forage in a variety of shallow wetland habitats with high concentrations of fish, such as freshwater marshes, ponds, and managed impoundments (FWS 1999). Primary prey includes fish between 2 and 25 cm (0.8 to 10 inches) in length, such as mosquito fish (*Gambusia affinis*), flagfish (*Jordanella floridae*), sailfin mollies, marsh killifish (*Fundulus confluentus*), yellow bullheads (*Ictalurus natalis*), and sunfish (*Centrarchidae*). FWS (1999) lists the Model Lands and Pennsuco wetlands, which are within the vicinity of Turkey Point, as significant foraging habitat for wood storks. Similarly, FWS (2007b) considers the Comprehensive Everglades Restoration Project, which occurs within the vicinity of Turkey Point, a major component to the wood stork's recovery plan in South Florida. One of the goals of this restoration project is to provide food resources to support a minimum of 2,500 successful nesting pairs, which is similar to historical nesting population levels for this species (FWS 2007b).

Wood storks use the action area for foraging, resting, and roosting. The FWS (2018c) considers the action area a core foraging area for this species. Most recently, while conducting

its CCS characterization study on December 5–7, 2016 (EAI 2017), FPL observed multiple wood storks foraging within the Turkey Point CCS. In addition, FPL (2014b) previously observed wood storks foraging in shallow portions of the CCS in June 2008, and the NRC (2015) noted that three storks were observed foraging and roosting in shallow mangrove wetlands immediately west of the proposed Turkey Point Unit Nos. 6 and 7 site. The closest known wood stork nest is 20 miles (32 km) southwest of Turkey Point, within the Everglades National Park (FPL 2018a).

6.1.1.4 Everglade Snail Kite

The FWS listed the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) as endangered in March 1967 (32 FR 4001). This medium-sized hawk has a wingspan of about 45 inches (114 cm) and primarily occurs in lowland freshwater marshes. In Florida, the population appears to be restricted to the Everglades, Lake Okeechobee, Lake Kissimmee, and the upper St. Johns River watersheds. The Everglade snail kite's diet is composed almost entirely of apple snails (*Pomacea paludosa*) (FWS 1999). Everglade snail kites have been observed immediately adjacent to the Turkey Point action area within the Everglades Mitigation Bank (FPL 2018a). In addition, from 2010 to 2012, the FFWCC (2013) observed at least 14 snail kites along the L-31 levee. FWS (2003) established a snail kite conservation area that includes much of southern Florida but excludes the Turkey Point site. FWS-designated critical habitat for the snail kite exists in western Miami-Dade County beginning about 22 miles (35 km) west of the Turkey Point site.

FPL (2018a) is not aware of any Everglade snail kite occurrences within the Turkey Point site. A limited amount of sawgrass marsh, which can provide habitat for apple snails (the snails that form almost the entirety of the snail kite's diet), occurs within the action area.

6.1.1.5 Kirtland's Warbler

The FWS listed the Kirtland's warbler as endangered in March 1967 (32 FR 4001). This species is a songbird and one of the rarest warblers. Its nesting habitat is confined to a small area in central Michigan (FWS 1999). Kirtland's warblers migrate from breeding grounds in Michigan to wintering habitat in the Bahamas. During the spring migration, FWS (1999) did not report any known stopover locations within Miami-Dade County. During the fall migration, Sykes (1996) reported that Kirtland's warblers occasionally rest within Miami-Dade County. Stevenson and Anderson (1994) reported the warbler's preferred stopover habitat to include dense vegetation less than 1.5-m (4.9-feet) tall; however, it has been observed in a variety of stopover habitats including woodlands, scrub, fencerows, and vegetated yards. Kirtland's warblers prey upon insects and larvae both on the ground and in midlevel-vegetation (FWS 1999).

FPL (2018a) is not aware of any Kirtland's warbler occurrences on the Turkey Point site, although suitable stopover habitat does occur within the action area. Given how infrequently this species rests mid-migration within Miami-Dade County, the NRC staff finds that there is a low likelihood that Kirtland's warblers occur within the action area.

6.1.2 Impacts

In Section 6.1.1, the NRC staff determines that the rufa red knot, piping plover, Everglade snail kite, and Kirtland's warbler are not likely to occur within the action area due to the small amount of suitable habitat in the action area and the migration routes of these species. If any of these

bird species use the action area, it would likely be for temporary rest or foraging. FPL has observed the wood stork occurring within the action area and foraging within the CCS. Therefore, the below analysis focuses on potential impacts of continued operation on the wood stork, given that out of the five federally listed bird species, it is the only one that has been observed within the action area. Potential impacts to all of the listed birds include collisions with plant infrastructure, the degradation of wetland habitats, reduction in prey resources in the CCS, and human disturbances from plant operational activities.

6.1.2.1 Collisions with Plant Infrastructure

Direct mortality of listed birds could occur if individuals collide with plant structures or in-scope transmission lines. The likelihood of collisions is extremely unlikely because suitable habitat for the listed bird do not occur near major plant structures or in-scope transmission lines. In NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the GEIS), the NRC staff determined that cooling towers present the greatest risk for bird collisions at nuclear power plants (2013); however, Turkey Point has no cooling towers. In addition, other than the wood stork, the listed birds are rare in the action area and would only occur in the action area for a short period of time each year, if at all. Lastly, the ESA requires FPL to take action in the event that site personnel discover an injured or dead individual associated with a collision. The NRC staff is not aware of any known reports or incidents.

FPL also minimizes the impacts on bird species from collisions with in-scope transmission lines through its voluntary corporate avian protection plan. In 2005, the FWS and the Avian Power Line Interaction Committee (a utility industry group focused on protecting birds) jointly released guidelines for utilities to create their own voluntary avian protection plans including bird mortality reporting, bird injury protocols, nest-management procedures, permitting issues, construction design standards to minimize collision and electrocution, staff training, and mortality risk assessment (FPL 2018a).

Because listed birds are not likely to occur near major plant structures and in-scope transmission lines, because the NRC staff is not aware of any known collisions, and because FPL maintains a voluntary corporate avian protection plan, the NRC staff finds that the likelihood of collision during the remainder of the current license and the period of extended operations would be very unlikely.

6.1.2.2 Impacts to Wetland Habitat

The principal threat to the survival and recovery of the wood stork is the loss, fragmentation, alteration, and degradation of its wetland habitat (FWS 2017a). In addition, runoff from phosphorus and nitrogen from agricultural and urban sources has degraded water quality within wetland habitats by altering the composition and structure of wetland plant communities used by the wood stork. These threats have resulted in reduced foraging and nesting opportunities for the wood stork. (FWS 2017a)

The FWS (2007b) determined that a major key to wood stork recovery in South Florida is the Comprehensive Everglades Restoration Project. This project, as well as the Model Land Project, is located immediately adjacent to Turkey Point, and the primary goal of these projects is to restore and protect wetland habitat. Indirect impacts to wetland habitat could occur due to the hypersaline plume associated with the CCS, dewatering activities, and site runoff. However, as discussed above in Section 5.1.2.4, the NRC staff determined that impacts to wetlands would be minimal based on FPL's wetland monitoring data, SFWMD's modeling studies, and FPL's

efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan. Given that these impacts would result in minor if any changes to wetland habitats, the NRC staff determined that continued operations would have an insignificant impact on the vegetative community or other prey resources for the wood stork and other listed birds. As such, wetlands within the action area would continue to provide foraging habitat for wood storks and other listed birds and continued operation of Turkey Point Unit Nos. 3 and 4 would not adversely impact foraging activity for wood storks or other listed birds.

6.1.2.3 Loss of Prey in the CCS

The CCS and adjacent wetlands provide foraging habitat for wood storks, which primarily consume fish between 2 to 25 cm (0.8 to 10 inches) in length such as mosquito fish, flagfish, sailfin mollies, marsh killifish, yellow bullheads, and sunfish. As described above in Section 5.1.2.3, the CCS went through a pronounced ecosystem shift whereby the number of fish species and density of fish is likely lower than prior to 2009 and submerged aquatic is absent from the CCS. Despite this fundamental shift in species composition within the CCS, EIA (2017) observed wood storks foraging within the CCS and determined that prey for the wood stork continued to populate the CCS in 2016. For example, sailfin mollies are moderately abundant throughout the CCS and this species is also able to tolerate high salinities (up to 80 psu), high temperatures (up to 40 °C (104 °F)), and low dissolved oxygen (Fischer and Schlupp 2009; Nordlie et al. 1992; Timmerman and Chapman 2004; EIA 2017). Therefore, wood storks are likely to continue to forage within the CCS, even at the elevated temperature and salinity levels. Given that the CCS continues to provide prey items for the wood stork, that those prey items can tolerate high salinity and temperature levels, and that the wood stork continues to forage within the CCS, the NRC staff finds that any impact to the wood stork would be minimal.

The FWS (2007b) determined that exotic species in wood stork wetland habitats can interfere with foraging activities due to the density and canopy cover of invasive species. As described above in Section 5.1.2.7, FPL annually removes exotic species, such as Australian pine and Brazilian pepper, from within the CCS canals and berms and along the access and CCS perimeter roads. FPL's exotic vegetation removal program improves the foraging habitat for the wood storks and has a beneficial impact on listed bird species. In a response to an NRC staff request for additional information, FPL (2018b) stated that it will continue its voluntary exotic vegetation removal program during the period of extended operations.

6.1.2.4 Human Disturbances

Intense human disturbance may disrupt nesting or foraging activities of birds and reduce their ability to maintain adequate weights or provide sufficient care to eggs or chicks (FWS 2007b, Niles 2009, FWS 2015). While the action area does not provide any known nesting habitat for the five federally listed bird species, the action area does provide foraging and resting habitat for the threatened wood stork, and potentially provides such habitat for the four other listed birds considered in this analysis.

At Turkey Point, human disturbance is limited to workers because FPL does not allow the public to freely access the site. Operational activities—such as herbicide treatment, vegetative trimming and mowing, and infrastructure maintenance—could disturb or displace listed birds. However, most of these activities occur within the developed portion of the site, which is not the portion of the site with suitable bird habitat. Noise and human activity levels during the proposed period of extended operations would remain similar to levels during the current

operations and are thus unlikely to cause listed birds to avoid or abandon habitat within the action area. For the wood stork, the FWS (2007b) determined that human disturbances may disrupt nesting behavior, but the FWS did not find evidence that human disturbances significantly affect foraging behavior. This suggests that wood storks are relatively tolerant of human activity, especially activity that is ongoing.

As described above in Section 5.1.2.5, FPL uses heavy machinery to remove invasive species from the CCS and then burns the removed vegetation in accordance with a Florida Department of Agriculture and Consumer Services (FDACS)-issued burn permit (FPL 2018b). Within areas that FPL has defined as crocodile sanctuaries, FPL maintains all native species after removing exotic species. These crocodile sanctuaries also provide suitable foraging habitat for the wood stork. On all other berms, FPL uses power equipment to maintain a low level of small brush, grass, and weeds. Although removal and burning could disturb birds and result in increased sedimentation within the CCS, such impacts are likely minimized given that the burning activities occur in accordance with the FDACS permit. In addition, work in or around active American crocodile nests sites is prohibited from March to August, which is also the time period when wood storks would be expected onsite. And finally, this removal and burning of invasive vegetation improves foraging habitats for wood storks.

6.1.2.5 Conclusion

Although five species of federally listed birds may occur within the action area, the NRC staff finds that any impacts on these bird species from the continued operation of Turkey Point Unit Nos. 3 and 4 would be insignificant or discountable for the following reasons:

- The rufa red knot, piping plover, Everglade snail kite, and Kirtland's warbler are not likely to occur within the action area due to the small amount of suitable habitat in the action area and the migration routes of these species.
- Collisions between listed birds and plant structures or in-scope transmission lines are unlikely given that no such collisions have occurred to date and that operational activities would remain the same during the remainder of the current license and the proposed subsequent license renewal period.
- Wetland degradation would be minimal based on FPL's current wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan.
- The loss of prey within the CCS does not appear to be significantly affecting the wood stork given that two fish species remaining in the CCS are prey for the wood stork and that the wood stork continues to forage in the CCS.
- Human disturbance of the federally listed birds in the action area would be insignificant because public access to the Turkey Point site would continue to be restricted during the proposed period of extended operations. Also, because noise levels and human activity would remain similar to the current operations, they would not likely cause listed birds to avoid or abandon habitat within the action area.

Based on the above information, the NRC staff finds that the proposed action may affect, but is not likely to adversely affect, the rufa red knot, piping plover, wood stork, Everglade snail kite, and Kirtland's warbler.

6.2 Mammals

6.2.1 Life Histories

6.2.1.1 Florida Bonneted Bat

The FWS listed the Florida bonneted bat as endangered in November 2013 (78 FR 61004). It is one of the rarest bats in the world and the entire worldwide population is likely limited to a few hundred individuals (FFWCC 2018; 78 FR 61004). The Florida bonneted bat is the largest bat in Florida and grows to weigh 34 to 47 g (1.2 to 1.7 ounces). Although relatively little is known about the ecology of the Florida bonneted bat, this species has been observed roosting in palm trees, tree cavities, rock crevices, artificial bat houses, and within Spanish tiled roofs (78 FR 61004; FNAI 2000). In South Florida, bats primarily roost in trees and manmade structures. The availability of suitable roosting habitat is an important limiting factor (78 FR 61004). This species will forage within open water and freshwater wetlands in order to capture beetles, flies, and other insects (FFWCC 2018). Unlike most bats, the Florida bonneted bat produces a call that is audible to the human ear. Therefore, surveys of this bat can be conducted without ultrasonic acoustic equipment.

The Florida bonneted bat has been observed in the Turkey Point vicinity, such as along the L-31E canal and approximately 10 miles (16 km) from Turkey Point near the city of Homestead, FL and the Miami Zoo. FPL did not detect any bats during a 2-hour bat survey conducted between the Unit No. 3 and Unit No. 4 power blocks and an adjacent mangrove area (NRC 2015). Suitable roosting habitat, such as ornamental palm trees (FPL 2018a) and foraging habitat, such as freshwater wetlands and open water, occur within the action area.

6.2.1.2 Florida Panther

The FWS listed the Florida panther as federally endangered in March 1967 (32 FR 4001). Florida panthers are large, long-tailed cats that grow to weigh between 102 to 154 pounds (46 to 70 kilograms) and measure up to 7 feet (2 m) in length. This subspecies increased in population from 12 to 20 cats in the early 1970s to 120 to 230 cats in 2017 (FWS 2009; FWS 2017b). The current population of this species is limited to less than 5 percent of its historic range and exists as only one isolated breeding population (FWS 2009). The Florida panther currently occupies one of the least-developed areas in the eastern United States, which is a contiguous system of large private ranches and public conservation lands in Broward, Collier, Glades, Hendry, Lee, Miami-Dade, Monroe, and Palm Beach counties totaling more than 809,400 ha (2 million acres). The largest contiguous tract of panther habitat is in the Big Cypress Swamp and Everglades physiographic regions. Radio-telemetry surveys indicate that these panthers prefer native, upland forests, especially hardwood hammocks and pine flatwoods, over wetlands and disturbed habitats (FWS 2009).

The action area lies outside of the Florida panther focus area, which is the documented breeding range for this species. Wetlands within the vicinity of the action area occur within the primary zone of the Florida Panther focus area (Kautz et al. 2006; FWS 2007a). In October 2013, the SFWMD (2013) sighted an adult panther and a kitten in the Model Lands Basin approximately 2 miles (3.2 km) west of the Turkey Point boundary. FPL is not aware of any Florida panther observations on the Turkey Point site (NRC 2015; FPL 2018a).

6.2.1.3 West Indian Manatee

The FWS listed the West Indian manatee (*Trichechus manatus*), including the Florida manatee subspecies, as endangered in March 1967 and then reclassified it as threatened in May 2017 (82 FR 16668). The FWS designated critical habitat for this species in 1976, which includes the northern portion of Biscayne Bay and the portion of Card Sound south of the Turkey Point site (Figure 14). Designated critical habitat does not occur on the Turkey Point site; however, designated critical habitat does occur in the action area—specifically where barge activity would occur. Although population estimates include a relatively large degree of uncertainty for this species (FWS 1999), the FWS (2018b) reports a current upward trend for the species from 1,267 manatees in 1999 to 6,300 manatees in 2018.

Manatees are generalist herbivores that can feed on a variety of vegetation but prefer submerged aquatic vegetation, such as turtle grass and manatee grass (FWS 2018b). Manatees are tolerant of changes in salinity; however, manatees are sensitive to changes in temperature because they lack the thick insulating layer of blubber common to most other marine mammals (Smith 1993). During the summer, manatees primarily occur in shallow fresh, brackish, and marine waters along both coasts of Florida. Preferred habitat includes 10- to 16-foot (3- to 5-m)-deep waters with submerged aquatic vegetation in areas that are accessible to freshwater for drinking (FWS 2018b). Individuals rarely venture into water exceeding 20 feet (6 m). Conservation and natural threats to West Indian manatees include death and injuries from vessel strikes, loss of warm water habitats, tropical storms and hurricanes, health impacts as a result of harmful algal blooms, cold weather, and tidal entrapments (FWS 2001b; Runge et al. 2007; FWS 2018b).

Manatees occur within the action area in Biscayne Bay, including the barge-turning basin and in nearshore waters with seagrass beds (NRC 2015, FPL 2018a). The lack of surface water connections with the CCS prevent manatees from occurring on the Turkey Point site (FPL 2014b and 2018a). Manatees do occur in the vicinity within SFWMD canals that discharge to Biscayne Bay north of the Turkey Point facility, including the C-100, C-1, C-102, Military, C-103, North, Florida City, FPL (Sea Dade), Card Sound Road, and C-111 canals (FPL 2012b).

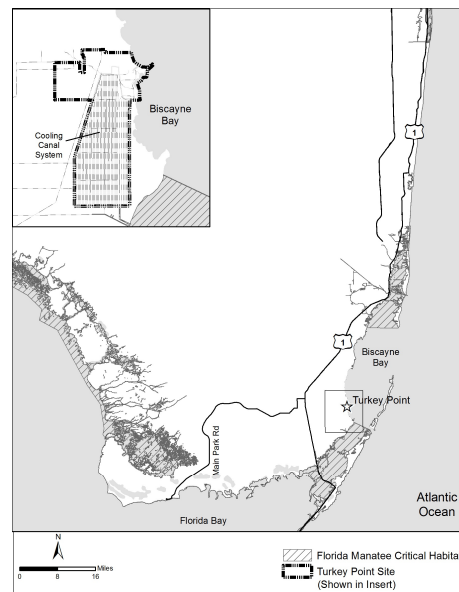


Figure 14 Critical Habitat for the West Indian Manatee near the Turkey Point Site

6.2.2 Impacts

6.2.2.1 Florida Bonneted Bat

For the Florida bonneted bat, the action area includes species-appropriate roosting habitat (such as ornamental palm trees) and foraging habitat (such as wetlands and open water) (FPL 2018a). However, FPL did not observe the Florida bonneted bat during its surveys within the action area (NRC 2015). Potential impacts to the Florida bonneted bat include direct mortality from collisions with plant infrastructure, loss of habitat or food resources, and human disturbances from operational activities.

Collisions with Plant Infrastructure

Direct mortality of Florida bonneted bats could occur if individuals collide with plant structures or in-scope transmission lines. The likelihood of collisions is extremely unlikely because this species is extremely rare in the action area. In addition, in-scope transmission lines and other tall buildings occur within the industrial portions of the site, which are not the portions of the site that contain suitable bat habitat. Lastly, the ESA requires FPL to take action in the event that site personnel discover an injured or dead Florida bonneted bat individual associated with a collision. The NRC is not aware of any known reports or incidents.

Because this species is rare within the action area, because no collisions are known to have occurred to date, and because bats are not likely to occur near tall plant structures that might pose a collision risk, the NRC staff finds that the likelihood of a collision between a Florida bonneted bat and plant structures or in-scope transmission lines would be very low.

Loss of Habitat or Food Resources

While the continued operation of Turkey Point Unit Nos. 3 and 4 would not result in any direct wetland loss or fragmentation, indirect impacts to wetland habitat could occur due to the hypersaline plume associated with the CCS, dewatering activities, and site runoff. However, as discussed above in Section 5.1.2.4, the NRC staff finds that impacts to wetlands would be minimal based on FPL's wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan.

The CCS may also provide foraging habitat for the Florida bonneted bat, which consumes insects in open waters. Although the CCS went through a major ecosystem shift from a seagrass-dominated system to an algal-dominated system, no data exist that describe the insect populations within the CCS. Nonetheless, any impacts to the Florida bonneted bat would be minimal because these bats are rare in the action area and, therefore, are unlikely to use the CCS for foraging.

Human Disturbances

Operational and maintenance activities that FPL might undertake during the remainder of the current license or during the proposed period of extended operations, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure) would primarily occur in disturbed areas and not within suitable habitat for this species. Noise levels and human activity would remain similar to the current operations and would not cause any additional disturbances that would cause bats to

avoid or abandon habitat within the action area. Therefore, the NRC staff finds that human disturbances during continued operations, such as disturbances from maintenance and infrastructure repair activities, would result in insignificant or discountable effects to the Florida bonneted bat.

Conclusion

The NRC staff finds that the continued operation of Turkey Point Unit Nos. 3 and 4 may affect, but is not likely to adversely affect, the Florida bonneted bat given that:

- Florida bonneted bats are rare within the action area
- The NRC staff is not aware of any known collisions with plant infrastructure
- Florida bonneted bats are not likely to occur near tall plant structures that might pose a collision risk
- Florida bonneted bats are unlikely to use the CCS as a regular or important foraging ground
- Human disturbances would be insignificant because public access to the Turkey Point site would continue to be restricted during the proposed period of extended operations. Also, because noise levels and human activity would remain similar to the current operations, they would not likely cause bats to abandon habitat, if they were to occur in the action area.

6.2.2.2 Florida Panther

Vehicular collisions is a significant threat to Florida panthers in South Florida (FWS 2017a) and likely the largest risk of injury or mortality to panthers within the action area. Nevertheless, the staff finds that collisions between vehicles and Florida panthers at Turkey Point are unlikely. FPL has not reported any incidents where operational activities resulted in injury or mortality to the Florida panther, and operational activities and levels will remain the same during the proposed period of extended operations (FPL 2018b). In addition, FPL is not aware of any Florida panther observations on the Turkey Point site (NRC 2015; FPL 2018a). This further suggests that vehicular collisions with Florida panthers within the action area are unlikely.

The greatest threat to the survival and recovery of the Florida panther throughout its range is habitat loss and habitat fragmentation due to commercial and residential development and other human activities (FWS 2017a). During the remainder of the current operating period and over the proposed period of extended operations, FPL (2018a) does not intend to conduct any refurbishment activities within the action area. In addition, the continued operation could result in beneficial impacts to the Florida panther. This is because FPL restricts public access to the site and also restricts development of the site for residential, commercial, or agricultural uses. These restrictions will remain in place during the remainder of the current license and during the proposed period of extended operations. In addition, the restricted public access reduces the likelihood of human disturbances to any Florida panther that may occur at Turkey Point.

Based on the lack of observations of this species within the action area, the low likelihood of vehicular collisions, the restricted public access (which minimizes disturbances), and the fact that no new construction activities would occur that would destroy or degrade panther habitat, the NRC staff finds that the proposed action may affect, but is not likely to adversely affect, the Florida panther.

6.2.2.3 West Indian Manatee

West Indian manatees occur in Biscayne Bay, including the parts of Biscayne Bay that fall within the action area (e.g., the parts of Biscayne Bay that are used for barge travel, the barge-turning basin, and nearshore waters in Biscayne Bay with seagrass beds). West Indian manatees do not occur within the CCS or in any other onsite Turkey Point waterbodies (NRC 2015, FPL 2018a). Critical habitat for the West Indian manatee also occurs within the action area, including the portion of Biscayne Bay and Card Sound adjacent to the southwest portion of the Turkey Point site. Impacts to the West Indian manatee during continued operation of Turkey Point Unit Nos. 3 and 4 include potential collisions with barge traffic and changes to water quality within Biscayne Bay.

Barge Traffic

Barge traffic associated with continued operation has the potential to impact manatees inhabiting Biscayne Bay. Continued operation of Turkey Point Unit Nos. 3 and 4 would likely require infrequent deliveries of large parts and equipment to the Turkey Point site by barges that would travel through parts of Biscayne Bay. FPL (FPL 2018b) estimates that every 4-to-5 years during the proposed period of extended operations, up to five barges in a single year would travel to and from Turkey Point. FPL's vessel traffic estimate includes deliveries associated with Turkey Point Unit Nos. 3 and 4; Turkey Point Unit Nos. 1, 2, and 5; and the onsite Turkey Point independent spent fuel storage installation (FPL 2018b).

These barges might collide with or strike manatees in Biscayne Bay and injure or kill them. However, the infrequency of vessel traffic and FPL's "Turkey Point Units 6 & 7 Barge Delivery Plan Barge Facility" (FPL 2009b) make such interactions unlikely. FPL's barge delivery plan supplements existing Turkey Point operational policies and procedures in accordance with U.S. Coast Guard requirements for fuel oil delivery. The barge delivery plan also requires FPL to notify the FFWCC and FWS if a barge collides with or injures a manatee. Given that FPL has reported no collisions with and/or injury to a manatee to date, and given the infrequency of deliveries during the proposed period of extended operations, the NRC staff finds that the likelihood of a manatee and barge collision as a result of the proposed action would be extremely low.

The NRC staff's findings on the impacts of Turkey Point barge traffic on manatees are in line with previous FWS findings. In 2017, the FWS assessed the impacts of barge traffic, among other effects, as part of its ESA Section 7 consultation with the NRC for FPL's proposed construction of two new nuclear power reactors at the Turkey Point site, Turkey Point Unit Nos. 6 and 7. The FWS noted that construction of Unit Nos. 6 and 7 would require regular and more frequent barge deliveries than expected for the continued operations of Unit Nos. 3 and 4. In addition, Turkey Point Unit Nos. 6 and 7 construction activities would include pile driving and basin dredging. The FWS also noted FPL's commitment to follow the Service's Standard Manatee Conditions for In-Water Work. Based on the above information, the FWS (2017a) determined that Turkey Point Unit Nos. 6 and 7 construction activities may affect, but were not likely to adversely affect, the West Indian manatee.

Biscayne Bay Water Quality

During the NEPA scoping period for the proposed action, the NRC received comments recommending that the staff consider interactions between the CCS and nearby surface waterbodies and how these interactions might potentially impact federally listed species. The

commenters' suggestions stemmed primarily from the concern that contaminants in the CCS could affect water quality in Biscayne Bay, which could affect federally listed species. The NRC staff evaluates this potential impact below.

At Turkey Point, FPL does not directly discharge cooling water or stormwater runoff from the CCS into Biscayne Bay. Therefore, any manatees in Biscayne Bay would not be exposed to contaminants from the CCS, at least not via a direct CCS-to-bay surface water pathway. However, there are other potential pathways. Specifically, the CCS and Biscayne Bay are both hydrologically connected to the Biscayne aquifer; therefore, manatee exposure could potentially occur via a groundwater and then a surface water pathway with water or contaminants first moving through the Biscayne aquifer and then into Biscayne Bay. As described in section 4.3.2.1, between June 2010 and May 2016, ammonia concentrations within the CCS ranged from below detection to 0.3 mg/L and averaged 0.04 mg/L. The Miami-Dade County water quality standard for ammonia is 0.5 mg/L. These measured ammonia values in the CCS are all below the county standard. Thus, ammonia

As part of the requirements of its consent order and consent agreement, FPL maintains an extensive water quality monitoring program. FPL monitors the CCS, Biscayne Bay, Card Sound, and other nearby waterbodies for ammonia, nitrogen, phosphorus, and chloride, among other nutrients and parameters. Additionally, ecological monitoring is conducted semiannually in Biscayne Bay and in mangrove areas and quarterly in marsh areas. In FPL's 2017 report, which analyzed data collected during the reporting period of June 1, 2016, through May 31, 2017, FPL identified no changes in Biscayne Bay water quality trends during the monitoring period when compared to past monitoring period results (E&E 2017). To date, FPL has identified no evidence of an ecological impact on the areas surrounding the CCS and no discernible influence from the CCS on Biscayne Bay, as summarized above in Section 4.3.3 (E&E 2017).

More recently, in July 2018, the DERM found that several sampling locations at the Barge Basin, Turtle Point Canal, Card Sound Canal, S-20 Get Away Canal, and the Sea-Dade Canal exceeded the applicable Miami-Dade County surface water standard for total ammonia concentration (MDC 2018). In a July 10, 2018, letter to FPL, the DERM acknowledged that the elevated concentrations may be attributable to a combination of several sources, including factors not directly related to the operation of the CCS. Nevertheless, because the DERM believes that the CCS may be one source contributing to the elevated ammonia levels, the DERM required FPL to take action to submit and implement a mitigation plan within 90 days of the date of the letter. The mitigation plan must address potential CCS nutrient impacts to groundwater and surface water resources beyond the boundaries of the system.

Elevated ammonia levels are of concern in aquatic environments because when present at high enough levels, aquatic organisms have difficulty completely excreting excess ammonia from their bodies. This can lead to toxic build-up, health and fitness effects, and, potentially, death. Several water quality parameters, including pH, temperature, and salinity; the rate or duration of exposure; and a species' specific physiobiology affect the extent to which an organism experiences toxicity from a given level of ammonia.

With regard to manatees, data on the effects of ammonia are not currently available. In the absence of species-specific information, the NRC staff assumes that the relevant State water quality criteria are reasonably protective of manatees because under Section 303(c) of the Clean Water Act, the Environmental Protection Agency or the State is required to adopt water quality standards to restore and maintain the chemical, physical, and biological integrity of the

Nation's waters. In delegated States, the Environmental Protection Agency must periodically certify that a State's water quality criteria, and any revisions thereto, protect the designated uses of the waterbody and that the standards are consistent with, or more protective than, the Environmental Protection Agency's national recommended aquatic life criteria. As described in Therefore, if waters inhabited by manatees meet water quality criteria for ammonia, the NRC staff assumes that there would be no lethal effects or impairment to growth, survival, or reproduction to manatee individuals.

As described above, the DERM has identified several sampling locations where the total ammonia concentrations have exceeded the water quality standard. However, the sampled locations are in stagnant or dead-end canals. If manatees were to be present in the canals, exposure time would be limited. Additionally, as described above, the DERM is taking action to restore water quality in the canal areas of elevated ammonia such that elevated ammonia levels are not expected to be a long-term issue. Further, no contaminants associated with the CCS, including ammonia, have been found in Biscayne Bay. In summary, because of the very low likelihood of manatees to be exposed to contaminants associated with the CCS, including ammonia, and because of the short duration of any such potential exposure, any effects on manatees would be insignificant or discountable.

Conclusion for Designated Critical Habitat for the West Indian Manatee

As described above, FPL does not directly discharge cooling water or stormwater runoff from the CCS into Biscayne Bay. It is possible, though, that nutrients and other contaminants originating from the CCS could enter Biscayne Bay through a groundwater-surface water connection. Therefore, FPL monitors the CCS, Biscayne Bay, Card Sound, and other nearby waterbodies for ammonia, nitrogen, phosphorus, and chloride, among other nutrients and parameters. Additionally, ecological monitoring is conducted semiannually in Biscayne Bay and in mangrove areas and quarterly in marsh areas. In 2017, FPL identified no changes in Biscayne Bay water quality trends when compared to past monitoring results (E&E 2017). To date, FPL has identified no evidence of an ecological impact on the areas surrounding the CCS and no discernible influence from the CCS on Biscayne Bay, as summarized above in Section 4.3.3 (E&E 2017). In 2018, the DERM indicated that total ammonia concentrations have exceeded the surface water standard at several sampling locations in canals that connect to Biscayne Bay and that the Turkey Point CCS may be one contributing factor.

The NRC staff finds that, given this information, continued operation of Turkey Point Unit Nos. 3 and 4 will not appreciably diminish the ecological value of designated critical habitat within Biscayne Bay for the manatee because:

- The identified areas of elevated ammonia are limited to localized areas such as stagnant or dead-end canals, which do not provide preferred habitat for manatees
- The DERM is requiring FPL to submit and implement a mitigation plan to address potential CCS nutrient impacts to groundwater and surface water resources beyond the boundaries of the CCS

Therefore, the proposed action is not likely to adversely modify designated critical habitat for the West Indian manatee.

Conclusion for the West Indian Manatee

Although the West Indian manatee may occur within the action area, the NRC staff determined that any impacts from continued operation of Turkey Point Unit Nos. 3 and 4 would be insignificant or discountable given that:

- Vessel strikes are unlikely based on the infrequent level of barge traffic, FPL's adherence to the mitigation measures outlined in its barge delivery plan, and the facts that no such collisions have occurred to date and that operational activities would remain the same during the remainder of the current license and the proposed period of extended operations
- The areas of elevated ammonia are limited to localized areas such as stagnant or dead-end canals
- Exposure to manatees would be limited to short periods of time and, therefore, is not expected to significantly impact manatee behavior
- The DERM is requiring FPL to submit and implement a mitigation plan to address potential CCS nutrient impacts to groundwater and surface water resources beyond the boundaries of the CCS

Based on the above information, the NRC staff finds that the proposed action may affect, but is not likely to adversely affect, West Indian manatees and would not adversely modify the manatee's designated critical habitat.

6.3 Plants

6.3.1 Life Histories

6.3.1.1 Blodgett's Silverbush

The FWS listed Blodgett's silverbush (*Argythamnia blodgettii*) as threatened in October 2016 (81 FR 66842). This perennial flowering plant occurs in sunny gaps and edges in pine rockland, rockland hammock, and coastal berm habitats (FNAI 2000). It is found in 18 conservation areas in Florida's Miami-Dade and Monroe counties (Gann et al. 2018), including in Biscayne National Park and Everglades National Park (both parks are in the vicinity of the Turkey Point site) (FNAI 2012). FPL (2018a) has observed Blodgett's silverbush within the vicinity of the action area. Limited suitable habitat, such as coastal berm habitats, could occur within the action area. However, given the limited amount of potentially suitable habitat for the Blodgett's silverbush within the action area, the NRC staff finds that there is a low likelihood that this threatened plant species occurs within the action area.

6.3.1.2 Cape Sable Thoroughwort

The FWS listed the Cape Sable thoroughwort (*Chromolaena frustrata*) as endangered in November 2013 (78 FR 63796). This perennial herb produces blue or lavender flower and currently grows only in Everglades National Park and on five islands in the Florida Keys. It grows in open canopy habitats (including coastal berms and coastal rock barrens) and in semi open to closed canopy habitats (including buttonwood forests, coastal hardwood hammocks, and rockland hammocks). Eleven populations of Cape Sable thoroughwort inhabit Everglades National Park and the species no longer occurs on Key Largo or other keys in the vicinity of the action area (78 FR 63796). This species has not been observed within the action area

(FPL 2018a). Limited suitable habitat, such as coastal berm habitats, could occur within the action area. However, given the limited amount of potentially suitable habitat in the action area, the NRC staff finds that there is a low likelihood that the Cape Sable thoroughwort occurs within the action area.

6.3.1.3 Florida semaphore cactus

The FWS listed the Florida semaphore cactus (*Consolea corallicola*) as endangered in November 2013 (78 FR 63796). This extremely rare cactus grows on coastal berms, coastal rock barrens, rockland hammocks, and buttonwood forests on sandy or limestone rockland soils with little organic matter. A wild population currently occurs on Swan Key in Biscayne National Park and Little Torch Key on a property belonging to the Nature Conservancy (FWS 2016). Reintroduced populations occur on Key Largo and on other keys. This species has not been observed within the action area (FPL 2018a). Limited suitable habitat for the semaphore cactus, such as coastal berm habitats, could occur within the action area. However, given the limited amount of potentially suitable habitat for this species in the action area, the NRC staff finds that there is a low likelihood that the Florida semaphore cactus occurs within the action area.

6.3.1.4 Sand Flax

The FWS listed the sand flax (*Linum arenicola*) as endangered in October 2016 (81 FR 66842). This forb grows in pine rocklands, marl prairie, and adjacent disturbed areas (FNAI 2000). The NRC (2015) determined that sand flax plants occur within the vicinity of the action area, near two of the proposed transmission line corridors associated with Turkey Point Unit Nos. 6 and 7. This species also occurs in Homestead Bayfront Park, which is less than 1 mile (1.6 km) north of the Turkey Point site boundary (FNAI 2000). This species has not been observed within the action area (FPL 2018a). Given the limited amount of potentially suitable habitat for this species in the action area, the NRC staff finds that there is a low likelihood that this species occurs within the action area.

6.3.1.5 Florida Bristle Fern

The FWS listed the Florida bristle fern (*Trichomanes punctatum* ssp. *floridanum*) as endangered in November 2015 (80 FR 60440). This fern grows in rockland hammocks, sinkhole habitats (Gann et al. 2018), and on tree trunks in deep shade (NatureServe 2010). In Miami-Dade County, four Florida bristle fern populations exist. The fern grows on rocks or other plants, usually in rocky outcrops of rockland hammocks, in oolitic (composed of minute rounded concretions resembling fish eggs) limestone solution holes and, occasionally, on tree roots in limestone-surrounded areas (80 FR 60440). This species has not been observed within the action area (FPL 2018a). Given the limited amount of potentially suitable habitat for this species in the action area, the NRC staff finds that there is a low likelihood that the Florida bristle fern occurs within the action area.

6.3.2 Impacts

In Section 6.3.1, the NRC staff determined that it was unlikely for the Blodgett's silverbush, Cape Sable thoroughwort, Florida semaphore cactus, sand flax, and the Florida bristle fern to occur within the action area due to limited suitable habitat. Potential impacts to these federally listed plant species include habitat degradation from runoff of contaminants, sediments,

herbicides, and oils, and ground disturbing activities from landscaping, maintenance, and repair of plant infrastructure, removal of invasive species, and other operational activities.

6.3.2.1 Habitat Degradation

Indirect impacts to wetland habitat could occur due to the hypersaline plume associated with the CCS, dewatering activities, and site runoff. However, as discussed above in Section 5.2.4, the NRC staff finds that impacts to wetlands would be minimal based on FPL's wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan.

In addition, FPL (2018a) applies commercially approved herbicides in accordance with its Florida site certification application and applicable Federal and State regulations. For example, FPL must notify the FDEP Southeast District of the Department of Siting Coordination Office at least 60 days prior to the first use of an herbicide. The distance of herbicide treatments to suitable habitats of listed plant species suggests that if any listed plants were to occur within the action area, the effects from herbicide treatment would be discountable.

Given that these impacts would result in minor if any changes to wetland or other suitable habitats, the NRC staff determined that continued operations would have an insignificant impact on the water quality or other factors that could significantly alter the vegetative community within the action area. As such, the proposed action would not adversely impact any listed plants within the action area.

6.3.2.2 Conclusion

Although five species of federally listed plants have the potential to occur within the action area, the NRC staff finds that any impacts on these plants from continued operation of Turkey Point Unit Nos. 3 and 4 would be insignificant or discountable for the following reasons:

- Blodgett's silverbush, Cape Sable thoroughwort, Florida semaphore cactus, sand flax, and the Florida bristle fern are not likely to occur within the action area due to the small amount of suitable habitat.
- FPL does not intend to conduct any major construction activities during the proposed period of extended operations.
- Degradation to suitable habitat for the above-listed plant species would be negligible based on FPL's current wetland monitoring data, SFWMD's modeling studies, and FPL's efforts to minimize impacts through implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan.

Based on the above information, the NRC staff finds that the proposed action may affect, but is not likely to adversely affect, the Blodgett's silverbush, Cape Sable thoroughwort, Florida semaphore cactus, sand flax, and Florida bristle fern plant species.

6.4 Impacts Common to All Species

The below analysis examines impacts that would be common to all species included in this Biological Assessment.

6.4.1 Potential Radiological Exposures

The NRC staff addressed the potential for radioactive contaminants associated with license renewal to affect terrestrial and aquatic biota generically in NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (GEIS) (NRC 2013). The GEIS determined that radionuclides may be released from nuclear power plants into the environment via a number of pathways. Releases into terrestrial environments often result from deposition of small amounts of radioactive particulates released from power plant vents during normal operations. Radionuclides may also be released into the aquatic environment from the liquid effluent discharge line. Radionuclides that enter shallow groundwater can be taken up by terrestrial plant species, including both upland species and wetland species, where wetlands receive groundwater discharge. Terrestrial biota may be exposed to ionizing radiation from radionuclides through direct contact with water or other media, inhalation, or ingestion of food, water, or soil.

The NRC (2013) examined dose exposure rates for terrestrial and aquatic animals and plants at 15 power plant sites based on reported radionuclide concentrations in water, sediment, and soils at each site. The NRC staff determined that exposure to radionuclides would be of SMALL significance for terrestrial and aquatic organisms for all nuclear power plants because exposure would be well below U.S. Environmental Protection Agency and U.S. Department of Energy guidelines developed to protect biota. The NRC defines “SMALL” to mean that environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource (10 CFR Part 51, Appendix B to Subpart A, Table B-1, “Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants”). Such an effect level equates to “insignificant” in ESA terminology—in other words, the effects would never reach the scale where a take would occur and, based on best judgement, a person would not be able to meaningfully measure, detect, or evaluate such effects.

6.4.2 Ground Disturbing Activities

FWS (2009) determined that habitat loss and fragmentation from residential and commercial construction, agriculture, and timbering threatens many listed species in southern Florida. FPL does not intend to conduct any refurbishment activities as part of the proposed action. FPL will continue to restrict public access to the Turkey Point site and to block future development of the site for residential, commercial, or agricultural activities during the proposed period of extended operations.

FPL’s (2018a and 2018b) landscape maintenance and operational activities would continue during the period of extended operations. The practices primarily consist of mowing, weed and hedge trimming, physical or chemical weed removal, herbicide application, tree trimming, brush removal, debris removal, and the maintenance and repair of plant infrastructure such as roadways, piping installations, fencing, and security-related structures. Such activities would result in limited ground disturbances. However, the majority of these activities would occur within the industrialized portion of the action area, which does not provide suitable or preferred habitat for the listed species within this assessment. In addition, FPL’s environmental control program and the CCS berm maintenance procedures, which continue during the period of extended operations, would minimize the majority of impacts, as described below.

FPL follows, and intends to continue to follow during the period of extended operations, its environmental control program for maintenance activities or other ground disturbing activities that could result in land clearing or excavation, or could result in other activities which would

alter the physical environment or ecology of the site. The procedures direct FPL personnel to obtain appropriate local, State, or Federal permits (or some combination of the three) prior to beginning work; familiarize themselves with existing permit and procedural requirements to protect ecological resources; implement best management practices to protect wetlands, natural heritage areas, and sensitive ecosystems; and consult the appropriate agencies, such as FWS, wherever Federal or State-listed species may be affected. In addition, the procedures include environmental review questions and checklists that screen activities for compliance with current requirements and identify activities that would cause environmental impacts, such as disturbances to natural areas or impacts to wetlands.

Ground disturbing activities could increase erosion or runoff of sedimentation into wetlands or other sensitive habitats. Sedimentation can lead to changes in water quality and the community composition of terrestrial and aquatic biota. At Turkey Point, stormwater is collected in drainage channels and floor drains, and then is discharged directly to the CCS. No stormwater is directly discharged into Biscayne Bay or surface waters other than the CCS. Use of the stormwater conveyance system, which collects stormwater, minimizes the amount of excess runoff that terrestrial habitats would receive and the associated effects. In addition, FDEP regulations require a stormwater permit and SWPP plan for any construction activities, or activities that would result in the clearing of land, excavation, or other action which would alter the physical environment or ecology of the site. FPL's SWPP plan identifies potential sources of pollutants that could affect stormwater discharges and identifies best management practices that FPL uses to reduce pollutants in stormwater discharges to ensure compliance with applicable conditions of the permit (FPL 2018b). The best management practices include soil stabilization such as seeding and structural controls (e.g. silt fences). Collectively, these measures ensure that the effects to terrestrial resources from pollutants carried by stormwater would be minimized.

In addition to minimizing impacts, many of FPL's procedures would result in beneficial impacts to suitable habitat for listed species. For example, FPL removes non-native species within the CCS berms as part of its maintenance procedures (FPL 2018b). Once non-native species are removed, FPL burns the removed vegetation in accordance with an FDACS-issued burn permit (FPL 2018b). Within areas that FPL has defined as crocodile sanctuaries (which also provide habitat for other listed species), FPL maintains all native species after removing exotic species. On all other berms, FPL uses power equipment to maintain a low level of small brush, grass, and weeds.

7.0 Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the proposed action.

8.0 Cumulative Effects

Cumulative effects are those effects that may result from future State, county, local, or private activities—though not Federal activities—that are reasonably certain to occur within the action area of a Federal action that is subject to ESA Section 7 consultation (50 CFR 402.02, "Definitions"). When the FWS or the National Marine Fisheries Service (1998) formulate biological opinions under formal ESA Section 7 consultation, they consider cumulative effects

when determining the likelihood of jeopardy or adverse modification. Therefore, Federal agencies need only consider cumulative effects under the ESA if a federally listed species will be adversely affected by the proposed action and formal ESA Section 7 consultation is necessary (FWS 2014b). The below analysis focuses on future State, local, or private activities that may affect the American crocodile and the eastern indigo snake in the action area.

In Section 6.0 of the NRC's Biological Assessment related to the proposed action of issuing COLs for Turkey Point Unit Nos. 6 and 7, the NRC (2015) staff described the cumulative impacts that American crocodiles and eastern indigo snakes on and near the Turkey Point site may experience. In its cumulative impacts assessment, the NRC staff considered the historical context of the region—including prior drainage, development, and other modifications within South Florida—and the concomitant loss in species diversity and habitat. Present and reasonably foreseeable activities that the NRC staff considered in the analysis included private, State, and local activities at Turkey Point, population growth and development, and global climate change. These activities included the loss, degradation, and fragmentation of habitat; increased disturbance to the species from construction activities; and an increase in potential for injuries and deaths of these species due to collisions with motor vehicles. In addition, the NRC (2015) staff considered the beneficial impacts from the continued operation of the Everglades and Biscayne National Parks and Florida Keys National Marine Sanctuary, the Comprehensive Everglades Restoration Plan, and the Model Lands Basin and Southern Glades Addition projects. These analyses are incorporated into this biological assessment by reference.

In 2017, the FWS issued its Biological Opinion related to the proposed action of issuing COLs for Turkey Point Unit Nos. 6 and 7. Within its Biological Opinion, FWS (2017) determined that cumulative impacts from State, county, local, and private activities would result in a reduction of habitat to the American crocodile and the eastern indigo snake. FWS (2017) determined that in the short term, this loss of habitat would not be significant, but over the long term (i.e., two or three decades), this amount of cumulative habitat loss has the potential to affect the survival of these species. FWS stated that it would continue to monitor the cumulative effects of development and other effects to these species in the action area and throughout their range.

Since the publication of the Biological Assessment in 2015, the NRC staff has determined that two new possible State, County, local, or private activities may occur near the action area: (1) possible construction and operation of a mine and (2) possible construction of a Miami-Dade County wastewater treatment facility. Construction of either facility could result in cumulative effects in the affected area that include both temporary and permanent loss of important foraging habitats, fragmentation of habitats of federally listed species, and degradation of habitats as a result of runoff, erosion, and sedimentation. If American crocodiles or eastern indigo snakes occur near either the mine or the wastewater treatment facility construction sites, individuals would likely avoid the areas during construction due to noise and other human disturbances. Collisions with vehicles could also result in American crocodile or eastern indigo snake mortality. Implementation of appropriate best management practices, revegetation following construction, and required compensatory mitigation for unavoidable wetland impacts would minimize such impacts. Furthermore, locating these projects in areas that have already been disturbed by extensive human activity would minimize potential impacts to important wetland habitats.

9.0 Conclusion and Determination of Effects

9.1 Species That May Be Adversely Affected

9.1.1 American Crocodile and Designated Critical Habitat

The NRC staff finds that the continued operation of Turkey Point Unit Nos. 3 and 4 may affect and is likely to adversely affect the American crocodile primarily due to takes associated with vehicular collisions. At Turkey Point, vehicular collisions are the leading cause of mortality for American crocodiles. From December 2011 through September 2018, FPL reported six vehicular collisions that resulted in crocodile mortality. These six collisions account for the majority of the reported American crocodile causal takes at Turkey Point.

The current 2006 biological opinion related to the operation of Turkey Point Unit Nos. 3 and 4 allows an incidental take of two American crocodiles between May 2006 through May 2011, and one American crocodile per year thereafter (FWS 2006b). FPL has not exceeded the current incidental take amount at any time since 2006. Given that operational activities at Turkey Point Unit Nos. 3 and 4 will remain similar during the proposed period of extended operations, the NRC staff expects a similar level of take during the remainder of the current license and during the period of extended operations.

Additionally, for the past several decades, FPL has implemented a crocodile management plan at the Turkey Point site that has resulted in significant, beneficial impacts to the American crocodile and its designated critical habitat. In reclassifying the species from endangered to threatened in March 2007, the FWS acknowledged that FPL's activities to create nesting habitat, monitor crocodile populations, and minimize disturbances during operations contributed to the substantial increases in nests, hatchlings, and adult population of crocodiles in Florida (71 FR 13027). More recently, however, the body condition for crocodiles has substantially declined from 2013 to 2015, and nest and hatchling abundance has also decreased. Squires et al. (2017) determined that the maximum air temperature and maximum salinity within the CCS negatively affected body condition for crocodiles. Squires et al. (2017) also concluded that crocodiles within the CCS exhibited higher physiological stress levels than crocodiles within the surrounding areas, likely due to starvation and dehydration. Based on the significantly higher physiological stress for crocodiles in the CCS, the significant relationship between salinity and crocodile body condition, and the reduction in nest and hatchling abundance, the NRC staff finds that the current conditions within the CCS are having an adverse impact on crocodiles. As described above, the operation of Turkey Point Unit Nos. 3 and 4 is contributing to changes in the CCS water quality (e.g. flow within the CCS), along with several other important environmental factors (e.g. rainfall, decomposition of vegetation within the CCS).

During the proposed period of extended operations, FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions will likely decrease the physiological stress for crocodiles, improve nesting habitat, and may allow for more crocodiles to reinhabit the CCS. Additionally, FPL (2018b) intends to continue to implement its crocodile management plan during the remainder of the current licensing period and throughout the period of extended operations, which the NRC staff expects will continue to result in substantial beneficial impacts to the American crocodile. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. FPL is required to implement the terms and conditions within its incidental take statement, as described above in Section 5.2.1. In

conclusion, the NRC staff finds that the current conditions within the CCS are having an adverse impact on American crocodiles nests, hatchlings, and body condition, and that these impacts will likely decrease as a result of the consent order and consent agreement that require FPL to freshen the CCS (FPL 2018b). The CCS will likely provide more favorable nesting and foraging habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

The NRC staff finds that the current conditions within the CCS are diminishing the value of critical habitat for American crocodiles. During the proposed period of extended operations, FPL's efforts to freshen the CCS, as required by the consent agreement and consent order described in Section 4.3.2.1, will improve the conditions in the CCS and reduce the impacts from the hypersaline, warm CCS water. The improved conditions within the CCS will likely increase the value of designated critical habitat within the CCS. The NRC staff also notes that FPL currently conducts, and intends to continue to conduct during the proposed period of extended operations, several activities that increase the value of designated critical habitat within the CCS, as discussed in Section 5.1.2.7. The NRC staff notes that not all portions of FPL's crocodile management plan are required by Federal, State, or local permits or agreements. In conclusion, the NRC staff finds that the current conditions within the CCS are diminishing the value of designated critical habitat within the CCS, and that the value of this designated critical habitat will likely increase as a result of the consent order and consent agreement that require FPL to freshen the CCS. Thus, the CCS will likely provide more favorable habitat once the terms of the consent order and consent agreement have been achieved, which is reasonably expected to occur prior to the start of the proposed license renewal terms for Turkey Point Unit Nos. 3 and 4 (2032 and 2033 to 2052 and 2053, respectively).

9.1.2 Eastern Indigo Snake

The NRC staff finds that continued operation of Turkey Point Unit Nos. 3 and 4 could result in adverse impacts to the eastern indigo snake because a substantial population of eastern indigo snakes occur on the Turkey Point site, snakes use the roadways within the action area for basking or moving in between habitats, and in 2007, a snake was killed by an FPL vehicle that was conducting an activity (e.g., removal of exotic vegetation) that will occur during the remainder of the current license and during the proposed period of extended operations. Therefore, the NRC staff finds it possible that a future vehicular collision could occur between Turkey Point vehicles and an eastern indigo snake.

The NRC staff notes that FPL currently conducts, and intends to continue to conduct during the period of extended operations, activities to minimize the potential for a vehicular collision, such as conducting employee training for eastern indigo snake awareness and posting signs around construction zones that contain pictures and descriptions of the snake, warnings against disturbing the snake, and contact information for reporting a sighting of the eastern indigo snake.

9.2 Species Not Likely to be Adversely Affected

The NRC staff finds that continued operation of Turkey Point Unit Nos. 3 and 4 may affect, but is not likely to adversely affect, the 13 species considered above in Section 6.0. Based on FPL's reported interactions and observations of threatened and endangered species and the habitat requirements and migration patterns for these 13 species, the NRC staff finds that most

of these species are not likely to occur within the action area for significant amounts of time. The potential impacts of the proposed action on these species associated with human activity, habitat disturbances, vehicle collisions, infrastructure collisions, and other activities are likely insignificant or discountable. Furthermore, FPL's security zone around the site and its restriction on public access and development provide protection from human disturbances, which is a beneficial impact to these species. FPL's activities also minimize impacts through the implementation of its environmental compliance procedures, best management practices, SWPP plan, and spill prevention control and countermeasures plan.

10.0 References¹

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

50 CFR Part 402. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 402, “Interagency Cooperation—Endangered Species Act of 1973, as Amended.”

50 CFR Part 17. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 17, “Endangered and Threatened Wildlife and Plants.”

32 FR 4001. U.S. Fish and Wildlife Service. “Endangered species.” *Federal Register* 32(48):4001. March 11, 1967.

40 FR 44149. U.S. Fish and Wildlife Service. “Listing of endangered and threatened fauna.” *Federal Register* 40(187):44149–44151. September 25, 1975.

43 FR 4026. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Listing of the eastern indigo snake as a threatened species.” *Federal Register* 43(21):4026–4029. January 31, 1978.

50 FR 50726. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Determination of endangered and threatened status for the piping plover.” *Federal Register* 50(238):50726–50734. December 11, 1985.

71 FR 13027. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Reclassification of the American crocodile Distinct Population Segment in Florida from endangered to threatened; final rule.” *Federal Register* 71(53):13027–13041. March 20, 2007.

78 FR 61004. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Endangered species status for the Florida bonneted bat.” *Federal Register* 78(191):61004–61043. October 2, 2013.

78 FR 63796. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Determination of endangered status for *Chromolaena frustrata* (Cape Sable thoroughwort), *Consolea corallicola* (Florida semaphore cactus), and *Harrisia aboriginum* (aboriginal prickly-apple); final rule.” *Federal Register* 78(206):63797–63821. October 24, 2013.

79 FR 73706. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Threatened species status for the rufa red knot.” *Federal Register* 79(238):73706–73748. December 11, 2014.

79 FR 37077. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Reclassification of the U.S. breeding population of the wood stork from endangered to threatened.” *Federal Register* 79(125):37077–37103. June 30, 2014.

80 FR 60440. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; Endangered species status for *Trichomanes punctatum* ssp. *floridanum* (Florida bristle fern); final rule.” *Federal Register* 80(193):60440–60465. October 6, 2015.

¹ References with Agencywide Documents Access and Management System (ADAMS) accession numbers can be accessed through the NRC’s Web-based ADAMS search engine at <http://adams.nrc.gov/wba/>. Click on the “Advanced Search” tab, choose the following criteria under “Document Properties”: “Accession Number” in the “Property” box and “is equal to” in the “Operator” box, and input the ADAMS accession number of the document in the “Value” box.

- 81 FR 7214. U.S. Fish and Wildlife Service and National Marine Fisheries Service. "Interagency cooperation—Endangered Species Act of 1973, as amended; Definition of destruction or adverse modification of critical habitat. final rule." *Federal Register* 81(28):7214–7226. February 11, 2016.
- 81 FR 66842. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; Endangered species status for *Chamaecrista lineata* var. *keyensis* (big pine partridge pea), *Chamaesyce deltoidea* ssp. *serpyllum* (wedge spurge), and *Linum arenicola* (sand flax), and threatened species status for *Argythamnia blodgettii* (Blodgett's silverbush); final rule." *Federal Register* 81(189):66842–66865. September 29, 2016.
- 82 FR 16668. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; Reclassification of the West Indian manatee from endangered to threatened." *Federal Register* 82(64):16668–16704. April 5, 2017.
- Arnold T.M., Zimmerman R.C., Engelhardt K.A.M., Stevenson J.C. 2017. Twenty-First Century Climate Change and Submerged Aquatic Vegetation in a Temperate Estuary: the Case of Chesapeake Bay. *Ecosystem Health and Sustainability* 3(7):1353283. Available at <<https://doi.org/10.1080/20964129.2017.1353283>> (accessed July 24, 2018).
- Clean Water Act of 1972, as amended (CWA). 33 U.S.C. Section 1251 et seq.
- Chervinski J. 1983. Salinity Tolerance of the Mosquitofish, *Gambusia affinis*. *Journal of Fish Biology* 22(1):9–11.
- Costa T.M.M., Soares-Gomes A. 2015. Secondary Production of the Fiddler Crab *Uca rapax* from Mangrove Areas Under Anthropogenic Eutrophication in the Western Atlantic, Brazil. *Marine Pollution Bulletin* 101(2):533–538.
- [EAI] Ecological Associates, Inc. 2017. *FPL Turkey Point Cooling Canal System Characterization Study*. Prepared for Florida Power & Light Company. 55 p. ADAMS Accession No. ML18247A514.
- [E&E] Ecology and Environment, Inc. 2017. *Turkey Point Plant Annual Monitoring Report*. Prepared for Florida Power & Light Company. September 2017. 415 p. Available at <<http://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents#>> (accessed June 13, 2018).
- Endangered Species Act of 1973, as amended (ESA). 16 U.S.C. Section 1531 et seq.
- Elliot-Smith E., Haig S.M., and Powers B.M. 2009. *Data from the 2006 International Piping Plover Census*. Reston, VA. U.S. Geological Survey. U.S. Geological Survey Data Series 426. ADAMS Accession No. ML14342A016.
- [FDEP] Florida Department of Environmental Protection. 2014. Order in the Matter of Florida Power and Light Company, DEP State License No. PA03-45, OGC No. 14–0741. December 23, 2014. ADAMS Accession No. ML15026A548.
- [FDEP] Florida Department of Environmental Protection. 2016a. Consent Order Between the Florida Department of Environmental Protection and Florida Power and Light. June 20, 2016. Available at <<https://www.miamidade.gov/environment/public-records.asp#0>> (accessed July 5, 2018).
- [FDEP] Florida Department of Environmental Protection. 2016b. Conditions of Certification, Florida Power & Light Company, Turkey Point Plant, Units 3 and 4 Nuclear Power Plant, Unit 5 Combined Cycle Plant, Facility ID No. 0250003, Miami-Dade County, Title V Air Operation Permit Renewal, PA 03-45E. March 29, 2016.

- [FDEP] Florida Department of Environmental Protection. 2017a. "Biscayne Bay Aquatic Preserves." September 5, 2017. Available at <<https://floridadep.gov/fco/aquatic-preserve/locations/biscayne-bay-aquatic-preserves>> (accessed June 14, 2018).
- [FDEP] Florida Department of Environmental Protection. 2017b. "Factsheet About Outstanding Florida Waters (OFW)." November 2017. Available at <https://floridadep.gov/sites/default/files/OFW%20factsheet_0.pdf> (accessed June 14, 2018).
- [FDEP] Florida Department of Environmental Protection. 2018. 62-302.532 Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion, OGC File No. 16-0241. 2018. Available at <<https://www.flrules.org/gateway/RuleNo.asp?title=SURFACE%20WATER%20QUALITY%20STANDARDS&ID=62-302.532>> (accessed July 3, 2018).
- [FFWCC] Florida Fish and Wildlife Conservation Commission. 2013. E-mail from J. Goff to C. Duberstein. Subject: Review of snail kite locations and the proposed power line through Everglades National Park and Water Conservation Area 3B. March 14, 2013. West Palm Beach, FL. ADAMS Accession No. ML14328A283.
- [FFWCC] Florida Fish and Wildlife Commission. 2018. "Florida Bonneted Bat (*Eumops floridanus*).". Available at <<http://myfwc.com/wildlifehabitats/profiles/mammals/land/bats/information/field-guide/florida-bonneted-bat/>> (accessed September 7, 2018).
- Fischer C., Schlupp I. 2009. Differences in Thermal Tolerance in Coexisting Sexual and Asexual Mollies (*Poecilia*, *Poeciliidae*, *Teleostei*). *Journal of Fish Biology* 74:1662–1668.
- [FNAI] Florida Natural Areas Inventory. 2000. *Field Guide to the Rare Plants and Animals of Florida*. Tallahassee, FL. ADAMS Accession No. ML12193A519.
- [FNAI] Florida Natural Areas Inventory. 2012. "Florida's Conservation Lands Interactive Map." Tallahassee, FL. Available at <<http://www.fnai.org/webmaps/ConLandsMap/>>. ADAMS Accession No. ML14287A531.
- Foti R., del Jesus M., Rinaldo A., Rodriguez-Iturbe I. 2012. Hydroperiod Regime Controls the Organization of Plant Species in Wetlands. *Proceedings of the National Academy of Sciences of the United States of America* 109(48):19596–19600. Available at <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3511740/>> (accessed August 27, 2018).
- [FPL] Florida Power & Light Company. 2000. *American Crocodile Monitoring Report: Activity Report for Permit #WX95031*. December 12, 2000. ADAMS Accession No. ML11168A043
- [FPL] Florida Power & Light Company. 2008. Turkey Point Logbook Entry on September 25, 2008. ADAMS Accession No. ML093100554
- [FPL] Florida Power & Light Company. 2009a. *Final Summary Report Botanical Survey for Rare, Threatened, and Endangered Plants-Turkey Point Proposed Transmission Lines*. L-2011-163 Attachment 6, Tetra Tech EC, Inc., Stuart, FL. ADAMS Accession No. ML11118A173.
- [FPL] Florida Power & Light Company. 2009b. *Turkey Point Units 6 & 7 Barge Delivery Plan Barge Facility*. Homestead, FL. ADAMS Accession No. ML12240A281.
- [FPL] Florida Power & Light Company. 2010a. *FPL Turkey Point Plant Annual American Crocodile (Crocodylus acutus) Report*. Federal Permit TE092945-1, State Permits WS06468a and WX06467a, Juno Beach, FL. ADAMS Accession No. ML11180A084

[FPL] Florida Power & Light Company. 2010b. *FPL Turkey Point Units 6 & 7 Threatened and Endangered Species Evaluation and Management Plan*. Revision 1, Homestead, FL. ADAMS Accession No. ML12240A282.

[FPL] Florida Power & Light Company. 2011. *Turkey Point Units 6 and 7 Section 404(b)(1) Alternatives Analysis*. 093-87652, Juno Beach, FL. ADAMS Accession No. ML11319A035.

[FPL] Florida Power & Light Company. 2012a. *Turkey Point Plant Comprehensive Pre-Uprate Monitoring Report, Units 3 & 4 Uprate Project*. Prepared by Ecology and Environment, Inc., Lancaster, NY. October 31, 2012. ADAMS Accession No. ML15026A503.

[FPL] Florida Power & Light Company. 2012b. *Turkey Point Units 6 & 7 Federal Biological Assessment for Six Listed Species*. L-2012-432, Juno Beach, FL. ADAMS Accession No. ML123390437.

[FPL] Florida Power & Light Company. 2012c. Turkey Point Logbook Entry on September 12, 2012. ADAMS Accession No. ML12263A251.

[FPL] Florida Power & Light Company. 2014a. *Turkey Point Plant Annual Post-Uprate Monitoring Report, Units 3 & 4 Uprate Project*. Prepared by Ecology and Environment, Inc., Lancaster, NY. August 2014. Available at <http://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents#> (accessed July 7, 2018).

[FPL] Florida Power & Light Company. 2014b. *Turkey Point Plant, Units 6 and 7 COL Application – Part 3: Environmental Report*. Revision 6, Juno Beach, FL. ADAMS Accession No. ML14342A011.

[FPL] Florida Power & Light Company. 2016a. *Turkey Point Plant Comprehensive Post-Uprate Monitoring Report Units 3 & 4 Uprate Project*. Prepared by Ecology and Environment, Inc., Lancaster, NY. March 31, 2016. Available at <http://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents#> (accessed July 7, 2018).

[FPL] Florida Power & Light Company. 2016b. *Turkey Point Plant Comprehensive Post-Uprate Monitoring Report Units 3 & 4 Uprate Project*. Prepared by Ecology and Environment, Inc., Lancaster, NY. August 2016. Available at <http://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents#> (accessed July 7, 2018).

[FPL] Florida Power & Light Company. 2016c. *Turkey Point Cooling Canal System Nutrient Management Plan*. September 16, 2016. 28 p. Available at <http://www.psc.state.fl.us/library/filings/2017/09365-2017/Support/EXH%2061%2020170007%20-%20Staff's%203rd%20INT%20No.%2062%20-%20Attachment%20No.%202.pdf> (accessed July 19, 2018).

[FPL] Florida Power & Light Company. 2016d. Turkey Point Logbook Entry on July 28, 2016. ADAMS Accession No. ML16214A285.

[FPL] Florida Power & Light Company. 2016e. *FPL Turkey Point Plant Annual American Crocodile (Crocodylus acutus) Report*. Federal Permit TE092945-3, Juno Beach, FL. Available at http://ecmrer.miamidade.gov:8080/hpi/search/default/proc_document/paramName=cs_casenu mber¶mValue=18-999¶mType=property/paramName=proc_document¶mValue=proc_document¶mType=type&pageNumber=1&sortAttr=cs_folio&sortOrder=-1 (accessed October 5, 2018).

[FPL] Florida Power & Light Company. 2017a. *Turkey Point Plant Annual Monitoring Report, September 2017*. Prepared by Ecology and Environment, Inc., Lancaster, NY. September 2017. Available at <<http://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents#>> (accessed July 7, 2018).

[FPL] Florida Power & Light Company. 2017b. 2017 Annual Turkey Point Power Plant Remediation/Restoration Report, Prepared for FPL by Ecology and Environment, Inc. November 2017. Available at <<http://prodenv.dep.state.fl.us/DepNexus/public/searchPortal>> (accessed July 9, 2018).

[FPL] Florida Power & Light Company. 2017c. *FPL Turkey Point Plant Annual American Crocodile (Crocodylus acutus) Report*. Federal Permit TE092945-3, Juno Beach, FL. Available at <http://ecmrer.miamidade.gov:8080/hpi/search/default/proc_document/paramName=cs_casenu_mber¶mValue=18-999¶mType=property/paramName=proc_document¶mValue=proc_document¶mType=type&pageNumber=1&sortAttr=cs_folio&sortOrder=-1> (accessed October 5, 2018).

[FPL] Florida Power & Light Company. 2017d. *Florida Power & Light Company, Turkey Point Plant Units 3 & 4, Power Plant Site Certification No. PA 03-45E, Post-Certification Submittal, Conditions of Certification No. XVII.B.1*. January 19, 2017.

[FPL] Florida Power & Light Company. 2018a. *Applicant's Environmental Report—Subsequent Operating License Renewal Stage, Turkey Point Nuclear Plant Units 3 and 4*. Juno Beach, FL: FPL. January 2018. 762 p. ADAMS Accession No. ML18037A838.

[FPL] Entergy Operations, Inc. 2018b. Letter from W. Maher, Senior Licensing Director, Florida Power & Light Company, to NRC Document Control Desk. Subject: Turkey Point Units 3 and 4 subsequent license renewal application environmental report request for additional information (RAI) responses. August 8, 2018. ADAMS Accession No. ML18247A509.

[FPL] Entergy Operations, Inc. 2018c. *FPL Turkey Point Plant Annual American Crocodile (Crocodylus acutus) Report*. Federal Permit TE092945-3, Juno Beach, FL. ADAMS Accession No. ML18247A533.

[FPL] Florida Power & Light Company. 2018d. *Ten Year Power Plant Site Plan, 2018 – 2027*. Submitted to Florida Public Service Commission. April 2018. Available at <<https://www.fpl.com/company/pdf/10-year-site-plan.pdf>> (accessed October 23, 2018).

[FPL] Entergy Operations, Inc. 2018e. Florida Power & Light Company, Turkey Point Plant Units 3 & 4, Power Plant Site Certification No. PA 03-45E, Post-Certification Submittal, Conditions of Certification No. XVII.B.1. March 20, 2018.

[FPL] Florida Power & Light Company. 2018f. Letter from W. Maher, Senior Licensing Director, Florida Power & Light Company, to NRC Document Control Desk. Subject: Turkey Point Units 3 and 4 subsequent license renewal application environmental report request for additional information (RAI) Set 1 Supplemental Responses. November 28, 2018. ADAMS Accession No. ML18334A101.

[FWS] U.S. Fish and Wildlife Service. 1980. *Selected Vertebrate Endangered Species of the Seacoast of the United States- The American Crocodile*. Biological Services Program, FWS/OBS-80/1.47. March 1980. Available at <<https://babel.hathitrust.org/cgi/pt?id=mdp.39015086412734;view=1up;seq=9>> (accessed October 2, 2018).

[FWS] U.S. Fish and Wildlife Service. 1999. *South Florida Multi-species Recovery Plan*. Atlanta, Georgia. 172 pp. Available at <https://www.fws.gov/verobeach/ListedSpeciesMSRP.html#jump4> (accessed August 28, 2018).

[FWS] U.S. Fish and Wildlife Service. 2001a. Letter from Ferrell LS to Carpenter C, Branch Chief, NRC. Subject: Concurrence on biological assessment for Turkey Point license renewal. December 7, 2001. ADAMS Accession No. ML013540417.

[FWS] U.S. Fish and Wildlife Service. 2001b. *Florida Manatee Recovery Plan*, (*Trichechus manatus latirostris*). Third Revision, Southeast Region, Atlanta, Georgia. ADAMS Accession No. ML12198A135.

[FWS] U.S. Fish and Wildlife Service. 2003. *Draft Snail Kite Consultation Area Map*. South Florida Ecological Field Services Office, Vero Beach, FL. ADAMS Accession No. ML12198A158.

[FWS] U.S. Fish and Wildlife Service. 2006a. Letter from Souza P, Acting Field Supervisor, South Florida Ecological Services Office, to Gillespie F, Division of License Renewal Director, NRC. Subject: Biological Opinion for Turkey Point Units 3 and 4. May 5, 2006. ADAMS Accession No. ML061430174.

[FWS] U.S. Fish and Wildlife Service. 2006b. Letter from Souza P, Acting Field Supervisor, South Florida Ecological Services Office, to Gillespie F, Division of License Renewal Director, NRC. Subject: Revision to Biological Opinion Regarding American Crocodiles at the Turkey Point Nuclear Plant. August 31, 2006. ADAMS Accession No. ML062420003.

[FWS] U.S. Fish and Wildlife Service. 2007a. Letter from P. Souza to D.S. Hobbie, dated February 19, 2007, regarding "Florida Panther Effect Determination Key." South Florida Ecological Services Office, Vero Beach, FL. ADAMS Accession No. ML12198A091.

[FWS] U.S. Fish and Wildlife Service. 2007b. Wood stork (*Mycteria americana*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office, Jacksonville, FL. September 21, 2007. Available at https://ecos.fws.gov/docs/five_year_review/doc1115.pdf (accessed September 12, 2018).

[FWS] U.S. Fish and Wildlife Service. 2008. *Eastern Indigo Snake*, *Drymarchon couperi*, 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Mississippi Ecological Services Field Office Jackson, Mississippi. Available at https://ecos.fws.gov/docs/five_year_review/doc1910.pdf (accessed September 12, 2018).

[FWS] U.S. Fish and Wildlife Service. 2009. Florida Panther (*Puma concolor coryi*) 5-Year Review: Summary and Evaluation. FWS Southeast Region South Florida Ecological Services Office Vero Beach, FL. Available at https://ecos.fws.gov/docs/five_year_review/doc4352.pdf (accessed September, 7, 2018).

[FWS] U.S. Fish and Wildlife Service. 2010. U.S. Fish and Wildlife Species Assessment and Listing Priority Assignment Form: *Chromolaena frustrata* (Cape Sable Thoroughwort). Washington, D.C. ADAMS Accession No. ML14230A018.

[FWS] U.S. Fish and Wildlife Service. 2011. Letter from L. Williams, Field Supervisor, FWS South Florida Ecological Services Office, to L. Bauer, Acting Chief of Environmental Review Branch, NRC. Subject: Conclusion of section 7 consultation for Turkey Point EPU. October 25, 2011. ADAMS Accession No. ML11306A160.

[FWS] U.S. Fish and Wildlife Service. 2013. Rufa Red Knot Ecology and Abundance. Supplement to Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*). Docket No. FWS-R5-ES-2013-0097, Washington D.C. ADAMS Accession No. ML14309A077.

[FWS] U.S. Fish and Wildlife Service. 2014a. Letter from C. Aubrey, Field Supervisor, FWS South Florida Ecological Services Office, to D. Wrona, Chief of Environmental Review Branch, NRC. Subject: Conclusion of section 7 consultation for Operation License Amendment for Turkey Point Power Plant. July 29, 2014. ADAMS Accession No. ML14210A170.

[FWS] U.S. Fish and Wildlife Service. 2014b. Guidance for Preparing a Biological Assessment. 6 p. Available at <<http://www.fws.gov/midwest/endangered/section7/pdf/BAGuidance.pdf>> (accessed September 8, 2017).

[FWS] U.S. Fish and Wildlife Service. 2015. Status of the species, red knot (*Calidris canutus rufa*). November 2015. Available at <https://www.fws.gov/verobeach/StatusoftheSpecies/20151104_SOS_RedKnot.pdf> (accessed September 12, 2018).

[FWS] U.S. Fish and Wildlife Service. 2016. Questions and Answers for the Florida Semaphore Cactus and Aboriginal Prickly-apple Critical Habitat Designations. Available at <<https://www.fws.gov/verobeach/NewsReleasesPDFs/20160121CHfor2FloridaCactiQandA.pdf>> (accessed September 12, 2018).

[FWS] U.S. Fish and Wildlife Service. 2017a. Letter from R. Hinzman, Field Supervisor South Florida Ecological Services Office, FWS to A. Williamson, Project Managers, NRC. Subject: Biological Opinion for Combined License for Turkey Point Nuclear Plant, Units 6 and 7. June 23, 2017. ADAMS Accession No. ML17177A673.

[FWS] U.S. Fish and Wildlife Service. 2017b. Florida Panther Population Estimate Updated. February 22, 2017. Available at <<https://www.fws.gov/southeast/news/2017/02/florida-panther-population-estimate-updated/>> (accessed September 7, 2018).

[FWS] U.S. Fish and Wildlife Service. 2018a. Letter from South Florida Ecological Services Field Office, FWS. Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project. December 14, 2018. ADAMS Accession No. ML18348A889.

[FWS] U.S. Fish and Wildlife Service. 2018b. West Indian manatee, *Trichechus manatus*. Available at <<https://www.fws.gov/southeast/wildlife/mammals/manatee/#>> (accessed September 7, 2018).

[FWS] U.S. Fish and Wildlife Service. 2018c. Wood Stork Nesting Colonies and Core Foraging Areas Active Within 2008–2017 in Florida. Available at <https://www.fws.gov/northflorida/WoodStorks/WOST_Data/2018_WOST_colonies_map_update_20180425.pdf> (accessed September 12, 2018).

[FWS and NMFS] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. March 1998. 315 p. Available at <http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf> (accessed September 8, 2017).

Gann G.D., Stocking C.G., and Collaborators. 2018. Floristic Inventory of South Florida Database Online. The Institute for Regional Conservation. Delray Beach, FL. Available at <<http://regionalconservation.org/ircs/database/database.asp>> (accessed May 28, 2018).

- Golder Associates, Inc. 2008. Cooling Canal System Modeling Report. January 13, 2008. ADAMS Accession No. ML13072A713.
- Johnson W.E. 1974. Morphological variation and local distribution of *Cyprinodon variegatus* in Florida. Master's Thesis. University of Central Florida.
- Kautz R., Kawula R., Hctor T., Comiskey J., Jansen D., Jennings D., Kasbohm J., Mazzotti F., McBride R., Richardson L., Root K. 2006. "How Much is Enough? Landscape-scale Conservation for the Florida Panther." *Biological Conservation* 130:118–133, New York, NY.
- Kushlan J.A., Mazzotti F.J. 1989. Population biology of the American crocodile. *J. Herp.* 23:7–21.
- Mayer F.L., Low J.B. 1970. The effect of salinity on widgeongrass. *The Journal of Wildlife Management* 34(3):658–661.
- Mazzotti F.J. 1989. Structure and function. Pages 42–57 in C.A. Ross ed. *Crocodiles and alligators*, Facts On File, Inc.; New York, NY. As cited in FWS (1999).
- Mazzotti F.J. 2015. Professor of Biology, University of Florida-Fort Lauderdale Research and Education Center, Fort Lauderdale, FL. Conversation with John Wrublik, U.S. Fish and Wildlife Service. As cited in FWS (2017).
- Mazzotti F.J., Cherkiss M.S. 2003. Status and Conservation of the American Crocodile in Florida: Recovering an Endangered Species while Restoring an Endangered Ecosystem. Fort Lauderdale Research and Education Center, Fort Lauderdale, FL.
- McPherson B.F., Halley R. 1996. The South Florida Environment—A Region Under Stress. U.S. Geological Survey Circular 1134, Washington, DC. ADAMS Accession No. ML12193A218.
- [MDC] Miami-Dade County. 2015. Consent Agreement, Miami-Dade County, through its Department of Regulatory and Economic Resources, Division of Environmental Resources Management, Complainant, v. Florida Power & Light Company, Respondent, regarding "redress alleged violations of Chapter 24 of the Code of Miami-Dade County located near, surrounding, or in the vicinity of the Cooling Canal System located at Turkey Point on FPL's property." Miami, FL. October 7, 2015. ADAMS Accession No. ML15286A366.
- [MDC] Miami-Dade County. 2018. Letter from W. Mayorga, Chief, Environmental Monitoring and Restoration Division, to M. Raffenberg, Sr. Director, Environmental Licensing and Permitting, Florida Power & Light Company. Subject: Site Assessment Report (SAR) dated March 17, 2017 and the SAR Supplemental Information dated November 11, 2017, submitted pursuant to Addendum 1 dated August 15, 2016 of the Consent Agreement between Florida Power & Light (FPL) and Miami-Dade County, Division of Environmental Resources Management for FPL's Turkey Point facility located at, near, or in the vicinity of 9700 SW 344 Street, Unincorporated Miami-Dade County, FL (DERM IW-3, IW-16, IW5-6229, DW0-10, CLI-2014-0312, CLI- 2016-0303, HWR-851). July 10, 2018. Available at <<http://ecmrrer.miamidade.gov:8080/hpi/search>> [Case Number HWR-00851] (accessed August 24, 2018).
- Moler P.E. 1991. American crocodile population dynamics. Final report to study No. 7532, Florida Game and Fresh Water Fish Commission, Bureau of Wildlife Research; Tallahassee, FL. As cited in FWS (1999).
- Morgan and Eklund, Inc. 2010. Topographic and Bathymetric Survey, Turkey Point Cooling Canals, Miami-Dade County Florida, for Florida Power and Light. June 2, 2010. Available at <<http://CCS-3-4-plan.com/>> (accessed July 18, 2018).

NatureServe. 2010. An Online Encyclopedia of Life. Arlington, VA. Available at <<http://www.natureserve.org/explorer/index.htm>>.

Niles, L.J., Sitters H.P., Dey A.D., Atkinson P.W., Baker A.J., Bennett K.A., Carmona R., Clark K.E., Clark N.A., Espoz C., Gonzalez P.M., Harrington B.A., Hernandez D.E., Kalasz K.S., Lathrop R.G., Matus R.N., Minton C.D., Morrison R.I., Peck M.K., Pitts W., Robinson R.A., Serrano I.L. 2008. Status of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere. Studies in Avian Biology No. 36, Cooper Ornithological Society, Riverside, CA.

Niles, L. 2009. Red knots wintering on the Florida Gulf Coast 2005–2009. Unpublished final report (Report on Red Knot Surveys in Florida 2008–2009). Neotropical Migrant Bird Conservation Act. Project #3556, Agreement #NJ-N31. As cited in FWS (2015).

Nordlie F.G., Haney D.C., Walsh S.J. 1992. Comparisons of salinity tolerances and osmotic regulatory capabilities in populations of sailfin molly (*Poecilia latipinna*) from brackish and fresh waters. Copeia 3:741–746.

[NRC] U.S. Nuclear Regulatory Commission. 2001. Letter from Carpenter C, Branch Chief, NRC, to Webb A, South Florida Ecological Services Office, FWS. Subject: Biological Assessment of Impacts to Threatened, Endangered, and Candidate Species at Turkey Point Units 3 and 4. August 28, 2001. ADAMS Accession No. ML012420099.

[NRC] U.S. Nuclear Regulatory Commission. 2002. Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Turkey Point Plant, Units 3 and 4, Final Report. Washington, DC: NRC. NUREG–1437, Supplement 5. January 31, 2002. 669 p. ADAMS Accession Nos. ML020280119, ML020280202, and ML020280226.

[NRC] U.S. Nuclear Regulatory Commission. 2002b. Florida Power and Light Docket No 50-250, Turkey Point Nuclear Generating Unit No. 3, Renewed Facility License No. DPR-31. Revised June 14, 2018. ADAMS Accession No. ML052790649.

[NRC] U.S. Nuclear Regulatory Commission. 2006a. Letter from Gillespie F, Division of License Renewal License Renewal Director, NRC, to Wrublik J, Vero Beach Ecological Services Office, FWS. Subject: Request to Initiate Formal Consultation for Ongoing Activities Related to the Operation of Turkey Point, Units 3 and 4. March 24, 2006. ADAMS Accession No. ML060860052.

[NRC] U.S. Nuclear Regulatory Commission. 2006b. Letter from Gillespie F, Division of License Renewal License Renewal Director, NRC, to Souza P, South Florida Ecological Services Office, FWS. Subject: Request Modification of Biological Opinion for Ongoing Activities Related to the Operation of Turkey Point, Units 3 and 4. June 29, 2006. ADAMS Accession No. ML061800100

[NRC] U.S. Nuclear Regulatory Commission. 2011a. Biological Assessment for Turkey Point, Units 3 and 4, Proposed Extended Power Uprate. August 2011. 37 p. ADAMS Accession No. ML112280292.

[NRC] U.S. Nuclear Regulatory Commission. 2011b. Letter from L. Bauer, Acting Chief of Environmental Review Branch, NRC, to C. Dohner, Southeast Regional Director, FWS. Subject: Request to reinitiate informal section 7 consultation for the proposed Turkey Point Plant, Units 3 and 4, extended power uprate. September 9, 2011. ADAMS Accession No. ML112280292.

[NRC] U.S. Nuclear Regulatory Commission. 2013. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Revision 1. Washington, DC: NRC. NUREG–1437, Volumes 1, 2, and 3. June 30, 2013. 1,535 p. ADAMS Accession Nos. ML13106A241, ML13106A242, and ML13106A244.

- [NRC] U.S. Nuclear Regulatory Commission. 2014a. Biological Assessment for Turkey Point, Units 3 and 4, Proposed Ultimate Heat Sink Temperature Increase. August 2011. 13 p. ADAMS Accession No. ML14205A548.
- [NRC] U.S. Nuclear Regulatory Commission. 2014b. Letter from D. Wrona, NRC, to L. Williams, FWS. Subject: Request to reinstate informal section 7 consultation for the proposed license amendment to increase the ultimate heat sink temperature limit at Turkey Point Nuclear Generating Units Nos. 3 and 4. July 25, 2014. ADAMS Accession No. ML14206A800.
- [NRC] U.S. Nuclear Regulatory Commission. 2014c. Turkey Point Nuclear Generating Unit Nos. 3 and 4—Issuance of Amendments under Exigent Circumstances Regarding Ultimate Heat Sink and Component Cooling Water Technical Specifications (TAC Nos. MF4392 and MF4393). April 8, 2014. ADAMS Accession No. ML14199A107.
- [NRC] U.S. Nuclear Regulatory Commission. 2015. Biological Assessment for the U.S. Fish and Wildlife Service, Prepared by the U.S. Nuclear Regulatory Commission and the U.S. Army Corps of Engineers for Florida Power and Light Company Turkey Point Units 6 and 7 Nuclear Project Combined License Application Docket Nos. 052-040 and 052-041 and Permit Application No. SAJ-2009-02417. February 2015. ADAMS Accession No. ML15028A372.
- [NRC] U.S. Nuclear Regulatory Commission. 2016. Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7, Final Report. NUREG-2176, Volumes 1, 2, 3, and Supplement 1. October 31, 2016. 2,092 p. ADAMS Accession Nos. ML16300A104, ML16300A137, ML16300A312, and ML16337A147.
- [NRC] U.S. Nuclear Regulatory Commission. 2018. Teleconference Summary between M. Moser, Biologist, NRC and L. Nester, Biologist, FWS. Call held on September 6, 2018. ADAMS Accession No. ML18270A146.
- Orianne Society. 2013. Eastern Indigo Snake (*Drymarchon couperi*) M-Rc Survey Form, 2013–2014. ADAMS Accession No. ML18247A529.
- Orianne Society. 2016. Eastern Indigo Snake (*Drymarchon couperi*) M-Rc Survey Form, 2016. ADAMS Accession No. ML18247A530.
- Runge M.C., Sanders-Reed C.A., Langtimm C.A., Fonnesbeck C.J. 2007. *A Quantitative Threats Analysis for the Florida Manatee (Trichechus manatus latirostris)*. Open-File Report 2007-1086. U.S. Geological Survey. Washington, DC. ADAMS Accession No. ML12240A299.
- [SFWMD] South Florida Water Management District. 2011. *Water Quality Characterization of Southern Miami-Dade County and Nearby FPL Turkey Point Power Plant Miami-Dade County*, Florida Technical Publication WS-31. July 2011. Available at <<https://www.sfwmd.gov/science-data/scientific-publications-sfer>> (accessed September 10, 2018).
- [SFWMD] South Florida Water Management District. 2013. South Florida Water Management District Patrol Summary, Model Lands October 18–31, 2013. West Palm Beach, FL. ADAMS Accession No. ML14328A521.
- [SFWMD] South Florida Water Management District. 2017. Water Use Individual Permit, Permit Number 13-06251-W, Florida Power and Light Turkey Point Groundwater Recovery Well System, and Water Use Staff Report. February 27, 2017. Available at <<http://my.sfwmd.gov/ePermitting/PopulateLOVs.do?flag=1>> [search permit # 13-06251-W] (accessed August 1, 2018).
- Smith, K.N. 1993. *Manatee Habitat and Human-Related Threats to Seagrass in Florida: A Review*. Department of Environmental Protection, Tallahassee, FL. ADAMS Accession No. ML12198A099.

- Specziar A. 2004. Life History Pattern and Feeding Ecology of the Introduced Eastern Mosquitofish, *Gambusia holbrooki*, in a Thermal Spa under Temperature Climate, of Lake Heviz, Hungary. *Hydrobiologia* 522: 249–260.
- Sprandel, G.L., Gore J.A., Cobb, D.T. 1997. *Winter Shorebird Survey. Final Performance Report*. Florida Game and Fresh Water Fish Commission. Tallahassee, FL. As reported in FWS (2015).
- Sprandel, G.L., Gore J.A., Cobb D.T. 2000. Distribution of Wintering Shorebirds in Coastal Florida. *Journal of Field Ornithology* 71(4):708–720. Ames, IA.
- Squires M., Briggs-Gonzalez V., Smith C., Cooke S.K., Cherkiss M.S., Mazzotti F.J. 2017. *2016 Annual Report: American Crocodile Monitoring Program for the Turkey Point Uprate. Prepared for Florida Power and Light Company*. Project #006030004321 and Contract #02348724. Available at <<http://prodenv.dep.state.fl.us/DepNexus/public/searchPortal>> [Permit/Application: PA03-45]. (accessed September 24, 2018).
- Stevenson, H.M., Anderson B.H. 1994. *The Birdlife of Florida*. University Press of Florida. Gainesville, FL. As reported in FWS (1999).
- Sykes, P.W., Jr. 1996. *Kirtland's Warbler*. Pages 113–123 In: Rodgers J.A., Jr., Kale H.W., II, and Smith, H.T., editors. *Rare and Endangered Biota of Florida*. Volume V: Birds. University Press of Florida. Gainesville, FL. As reported in FWS (1999).
- [Tetra Tech] Tetra Tech NUS, Inc. 2009. *Final Fish Surveys of the Turkey Point Property Associated with Units 6 and 7, June 23–24, 2009*. July 2009. p.5–11. ADAMS Accession No. ML11168A043.
- Tetra Tech. 2014. Technical Memorandum from P.F. Andersen and J.L. Ross to FPL regarding “Evaluation of Required Floridan Water for Salinity Reduction in the Cooling Canal System.” Pasadena, CA. May 9, 2014. ADAMS Accession No. ML14279A555.
- Timmerman C.M., Chapman L.J. 2004. Behavioral and Physiological Compensation for Chronic Hypoxia in the Sailfin Molly (*Poecilia latipinna*). *Physiological and Biochemical Zoology* 77(4):601–610.
- United States of America v. Florida Power & Light Company. Civil Action No. 70-328-CA (S.D. Fla September 10, 1971). Final Judgment. Available at <<http://elr.info/sites/default/files/litigation/1.20461.htm>> (accessed July 29, 2016).
- [UF] University of Florida. Undated a. “Sawgrass Marshes.” Available at <<https://www.floridamuseum.ufl.edu/southflorida/habitats/freshwater-marshes/sawgrass-marshes/>> (accessed August 27, 2018).
- [UF] University of Florida. Undated b. “Life in Seagrasses.” Available at <<https://www.floridamuseum.ufl.edu/southflorida/habitats/seagrasses/life/>> (accessed October 9, 2018).
- Vernberg F.J., Tashian R.E. 1959. Studies on the Physiological Variation Between Tropical and Temperate Zone Fiddler Crabs of the Genus *Uca* I. Thermal death limits. *Ecology* 40(4):589–593.
- Zanders I.P., Rojas W.E. 1996. Osmotic and Ionic Regulation in the Fiddler Crab *Uca rapax* Acclimated to Dilute and Hypersaline Seawater. *Marine Biology* 125:315–320.

Enclosure 1

Summary of Federally Listed Species under U.S. Fish and Wildlife Jurisdiction for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 Subsequent License Renewal Review

The NRC staff used U.S. Fish and Wildlife Service's Environmental Conservation Online System (ECOS) Information for Planning and Conservation (IPaC) tool to determine species that may be present in the Turkey Point Nuclear Generating (Turkey Point) Unit Nos. 3 and 4 subsequent license renewal action area. The tool identified 42 listed species under the U.S. Fish and Wildlife Service's sole jurisdiction with the potential to occur in the action area as well as designated critical habitat for 2 of these species (FWS 2018) (see Table 1, below). No proposed species, candidate species, or proposed designated critical habitat occurs within the action area (FWS 2018). Table 1 describes the habitat requirements, occurrence patterns, and Federal listing status for each of the 42 listed species.

In addition to these 42 species, the U.S. Fish and Wildlife Service (FWS) (2018b_letter) identified 4 species for which it holds joint jurisdiction with the National Marine Fisheries Service. These four species include three sea turtles (the loggerhead sea turtle (*Caretta caretta*), the leatherback sea turtle (*Dermochelys coriacea*), and the hawksbill sea turtle (*Eretmochelys imbricata*)) and one fish (the Atlantic Sturgeon (gulf Subspecies) *Acipenser oxyrinchus (oxyrhynchus) desotoi*). However, NRC staff determined that continued operation of Turkey Point Unit Nos. 3 and 4 would have no effect on any portions of the species' life cycles that are under FWS's jurisdiction (NRC 2018).

Table 1. Summary of Federally Listed Species under U.S. Fish and Wildlife Jurisdiction for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 Subsequent License Renewal Review

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally listed Status ^(a)
Mammals			
<i>Eumops floridanus</i>	Florida bonneted bat	Suitable roosting (e.g., palm trees, tree cavities, Spanish tiled roofs) and foraging habitat occurs at Turkey Point (FWS 2017); Observed within the vicinity of Turkey Point (FPL 2018a).	Endangered
<i>Puma concolor coryi</i>	Florida panther	Florida Panther Focus Area occurs in the vicinity of Turkey Point (FWS 1999); Observed 2 miles west of Turkey Point (SFWMD 2013).	Endangered
<i>Puma concolor (all sub species except coryi)</i>	puma	No known occurrences in Florida (FWS 1999; NRC 2016).	SAT

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally listed Status ^(a)
<i>Trichechus manatus</i>	West Indian manatee	Designated critical habitat occurs adjacent to Turkey Point; Observed in the vicinity of Turkey Point, including canals and nearshore seagrass beds in Biscayne Bay (FPL 2012; FPL 2018b).	Threatened
Birds			
<i>Ammodramus maritimus mirabilis</i>	Cape Sable seaside sparrow	Suitable habitat (mixed marl prairie) does not occur at Turkey Point; No known occurrences at Turkey Point (NRC 2015; FPL 2014).	Endangered
<i>Ammodramus savannarum</i>	Florida Grasshopper sparrow	Extirpated from Miami-Dade County (FWS 1999).	Endangered
<i>Aphelocoma coerulescens</i>	Florida scrub-jay	Extirpated from Dade County (FWS 1999).	Threatened
<i>Caladris rufa</i>	red knot	Suitable habitat, such as mudflats, salt marshes, and mangroves occur onsite at Turkey Point (FWS 2017); Observed onsite at Turkey Point (FPL 2014).	Threatened
<i>Campephilus principalis</i>	ivory-billed woodpecker	Likely extirpated from the United States; No known occurrences at or near Turkey Point (FWS 1999, NRC 2016).	Endangered
<i>Charadrius melodus</i>	piping plover	Suitable wintering habitat, such as beaches, mudflats, and sandflats, occurs onsite and within the vicinity of Turkey Point (FPL 2014, FPL 2018a); No documented occurrences onsite (FPL 2014; NRC 2015).	Threatened
<i>Mycteria americana</i>	wood stork	Suitable foraging, resting, and roosting habitat within the Turkey Point CCS and onsite wetlands; Regularly observed onsite (NRC 2015; EAI 2017; FPL 2018c).	Threatened
<i>Picoides borealis</i>	red-cockaded woodpecker	No known occurrences within Miami-Dade County (FWS 1999; NRC 2016).	Endangered
<i>Rostrhamus sociabilis</i>	Everglade snail kite	Suitable habitat (lowland freshwater marshes) occurs on and near Turkey Point (NRC 2015); Observed within the Everglades Mitigation Bank adjacent to Turkey Point (FPL 2014).	Endangered

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally listed Status ^(a)
<i>Setophaga kirtlandi</i>	Kirtland's warbler	Suitable habitat (dense mangroves) occurs on and near Turkey Point; No known observations onsite (NRC 2016; FPL 2018).	Endangered
<i>Vermivora bachmani</i>	Bachman's warbler	No observations of this species in the United States since 1988 (FWS 1999).	Endangered
Reptiles			
<i>Alligator mississippiensis</i>	American alligator	Suitable freshwater habitat occurs within the vicinity of Turkey Point (FPL 2018a).	SAT
<i>Crocodylus acutus</i>	American crocodile	Designated critical habitat at Turkey Point; Onsite wetlands provide habitat for nesting, rearing hatchlings, and foraging; Onsite adult and hatchling populations have existed for several decades (FPL 2018).	Threatened
<i>Drymarchon corais couperi</i>	eastern indigo snake	Suitable habitat, including freshwater marshes, mangroves, and cleared areas, occurs at Turkey Point; Regularly observed onsite (FPL 2018c).	Threatened
Invertebrates			
<i>Anaea troglodyta florialis</i>	Florida leafwing butterfly	Suitable habitat (pineland croton plants in pine rockland) does not occur at Turkey Point (FWS 2017; FPL 2018a).	Endangered
<i>Cyclargus (=Hemiargus) thomasi bethunebakeri</i>	Miami blue butterfly	Only known occurrences are within Key West National Wildlife Refuge (FPL 2018a).	Endangered
<i>Heraclides aristodemus ponceanus</i>	Schaus swallowtail butterfly	Suitable habitat (pineland croton plants in pine rockland) does not occur at Turkey Point (FWS 2017; FPL 2018).	Endangered
<i>Orthalicus reses</i>	Stock Island tree snail	Suitable habitat (hardwood hammocks primarily in the Florida Keys) does not occur at Turkey Point; No known occurrence within the vicinity of Turkey Point (FWS 1999; FPL 2018a).	Threatened
<i>Strymon acis bartrami</i>	Bartram's hairstreak butterfly	Suitable habitat, which is limited to pine rockland where its host plant, pineland croton, occurs, does not occur at Turkey Point (FWS 2017; FPL 2018a).	Endangered

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally listed Status ^(a)
Flowering Plants			
<i>Amorpha crenulata</i>	crenulate lead-plant	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Argythamnia blodgettii</i>	Blodgett's silverbush	Limited suitable habitat (coastal berm) may occur onsite at Turkey Point; Observed within the vicinity of Turkey Point (FPL 2011; Gann et al. 2018).	Threatened
<i>Brickellia mosieri</i>	Florida brickell-bush	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Chamaesyce deltoidea</i> ssp. <i>deltoidea</i>	deltoid spurge	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Chamaesyce deltoidea</i> <i>pinetorum</i>	pineland sandmat	Suitable habitat (pine rockland) does not occur at Turkey Point (NRC 2015; 82 FR 46691).	Threatened
<i>Chamaesyce garberi</i>	Garber's spurge	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Threatened
<i>Chromolaena frustrata</i>	Cape Sable thoroughwort	Limited suitable habitat (coastal rock barrens) may occur at Turkey Point. Species does not occur in disturbed areas (FWS 2010; FPL 2018; NRC 2016).	Endangered
<i>Consolea corallicola</i>	Florida semaphore cactus	Limited suitable habitat (coastal berms) may occur at Turkey Point (78 FR 63796; NRC 2016); No known occurrences at Turkey Point (NRC 2016; FPL 2018a).	Endangered
<i>Cucurbita okeechobeensis</i> ssp. <i>okeechobeensis</i>	Okeechobee gourd	No known occurrences in Miami-Dade County; Not likely to occur at Turkey Point due to lack of suitable habitat (NRC 2016; Gann et al. 2018; FPL 2018c).	Endangered
<i>Dalea carthagenensis</i> <i>floridana</i>	Florida prairie-clover	Suitable habitat not likely to occur at Turkey Point because some suitable habitats (e.g., pine rocklands, edges of rockland hammocks, and marl prairies) do not occur at Turkey Point and other suitable habitat (e.g., uplands) have been previously disturbed (NRC 2016; Gann et al. 2018; FPL 2018c).	Endangered

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally listed Status ^(a)
<i>Digitaria pauciflora</i>	Florida pineland crabgrass	Suitable habitat (marl prairie and pine rockland) does not occur at Turkey Point (NRC 2016; Gann et al. 2018; FPL 2018b).	Threatened
<i>Galactia smallii</i>	Small's milkpea	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Jacquemontia reclinata</i>	beach jacquemontia	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Linum arenicola</i>	sand flax	Potential to occur onsite given that this species grows less than 1 mile from Turkey Point and suitable habitat (i.e., pine rocklands, marl prairie, and adjacent disturbed areas) occurs within the vicinity (FPL 2018).	Endangered
<i>Linum carteri carteri</i>	Carter's small-flowered flax	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Polygala smallii</i>	tiny polygala	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017).	Endangered
<i>Sideroxylon reclinatum</i> ssp. <i>austrofloridense</i>	Everglades bully	Suitable habitat (pine rockland habitat, marl prairie habitat, and within the ecotone between both habitats) does not occur at Turkey Point (82 FR 46691).	Threatened
<i>Warea carteri</i>	Carter's mustard	Extirpated from Miami-Dade County (FWS 1999; FWS 2008).	Endangered
Ferns			
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	Florida bristle fern	Suitable habitat (rockland hammocks, sinkhole habitats, and tree trunks that are in deep shade) occur within the vicinity of Turkey Point (Gann et al. 2018; NRC); Potential habitat occurs at Turkey Point, although no known occurrences onsite (FPL 2018a).	Endangered

(a) "SAT" means federally listed due to similarity of appearance to an endangered or threatened species, "Endangered" means federally listed as endangered, and "Threatened" means federally listed as threatened under the regulations of 50 CFR Part 17, "Endangered and Threatened Wildlife and Plants," which implement the provisions of the Endangered Species Act of 1973, as amended.

Source: FWS 2018

The FWS (2018) identifies 23 federally listed animals that could occur within the Turkey Point action area. Based on the information in Table 1, the NRC staff determined that the following six species are extirpated from Miami-Dade County or are not known to occur within Miami-Dade County and, therefore, are not considered further within the biological assessment:

- Florida grasshopper sparrow (*Ammodramus savannarum*)
- Florida scrub-jay (*Aphelocoma coerulescens*)
- ivory-billed woodpecker (*Campephilus principalis*)
- red-cockaded woodpecker (*Picoides borealis*)
- Bachman's warbler (*Vermivora bachmani*)
- Miami blue butterfly (*Cyclargus* (= *Hemiargus*) *thomasi bethunebakeri*)

The following five species are not considered further within the biological assessment because no suitable habitat for these species occurs on the Turkey Point site, there are no known occurrences of the species onsite, and the species would not be expected to occur within the action area given the lack of suitable habitat:

- Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*)
- Florida leafwing butterfly (*Anaea troglodyta floralis*)
- Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*)
- Stock Island tree snail (*Orthalicus reses*)
- Bartram's hairstreak butterfly (*Strymon acis bartrami*)

The puma and American alligator are both considered federally listed because of their similarity in appearance to the endangered Florida panther (*Puma concolor coryi*) and the threatened American crocodile (*Crocodylus acutus*), respectively. A species that is listed due to similarity of appearance is not biologically endangered or threatened and is therefore not subject to ESA, Section 7 consultation. Therefore, these two species are not discussed further in the biological assessment.

The FWS (2018) identifies 19 federally listed endangered or threatened plant species that could occur within the action area. FPL (2018a, 2018b, 2018c) is not aware of any federally listed plant species on the Turkey Point site. The NRC staff did not identify any known occurrence of a listed plant species within the action area (FWS 1999, NRC 2016, FWS 2017, Gann et al. 2018); however, some listed plant species have been observed within the vicinity of the action area and have the potential to occur onsite (FPL 2011). The NRC staff also notes that not all areas of the Turkey Point site have been surveyed for federally listed plants. Based on this limited information, the NRC staff reviewed the habitat requirements for each of the 19 listed plant species in Table 1 to determine which plants have potential suitable habitat within the action area. The NRC staff determined that the following 14 species would not be expected to occur within the action area due to the lack of suitable habitat in the action area or because the plant species has been extirpated from Miami-Dade County.

- crenulate lead-plant (*Amorpha crenulata*)
- Florida brickell-bush (*Brickellia mosieri*)
- deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*)
- pineland sandmat (*Chamaesyce deltoidea pinetorum*)
- Garber's spurge (*Chamaesyce garberi*)
- Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*)
- Florida prairie-clover (*Dalea carthagenensis floridana*)

- Florida pineland crabgrass (*Digitaria pauciflora*)
- Small's milkpea (*Galactia smallii*)
- beach jacquemontia (*Jacquemontia reclinata*)
- Carter's small-flowered flax (*Linum carteri carteri*)
- tiny polygala (*Polygala smallii*)
- Everglades bully (*Sideroxylon reclinatum* ssp. *austrofloridense*)
- Carter's mustard (*Warea carteri*)

References

78 FR 63796. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; Determination of endangered status for *Chromolaena frustrata* (Cape Sable thoroughwort), *Consolea corallicola* (Florida semaphore cactus), and *Harrisia aboriginum* (aboriginal prickly-apple); final rule." *Federal Register* 78(206):63797–63821. October 24, 2013.

82 FR 46691. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; Endangered species status for *Dalea carthagenensis* var. *floridana* (Florida prairie-clover), and threatened species status for *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades bully), *Digitaria pauciflora* (Florida pineland crabgrass), and *Chamaesyce deltoidea* ssp. *pinetorum* (pineland sandmat); final rule." *Federal Register* 82(193):63797–63821. October 6, 2017.

[EAI] Ecological Associates, Inc. 2017. *FPL Turkey Point Cooling Canal System Characterization Study*. Prepared for Florida Power & Light Company. 55 p. ADAMS Accession No. ML18247A514. In: FPL 2018b, Attachment A, p. A-3. ADAMS Accession No. ML18247A509.

[FPL] Florida Power & Light Company. 2011. *Turkey Point Units 6 and 7 Section 404(b)(1) Alternatives Analysis*. 093-87652, Juno Beach, FL. ADAMS Accession No. ML11319A035.

[FPL] Florida Power & Light Company. 2012. *Turkey Point Units 6 & 7 Federal Biological Assessment for Six Listed Species*. L-2012-432, Juno Beach, FL. ADAMS Accession No. ML123390437.

[FPL] Florida Power & Light Company. 2014. *Turkey Point Plant, Units 6 and 7 COL Application – Part 3: Environmental Report*. Revision 6, Juno Beach, FL. ADAMS Accession No. ML14342A011.

[FPL] Florida Power & Light Company. 2018a. *Applicant's Environmental Report—Subsequent Operating License Renewal Stage, Turkey Point Nuclear Plant Units 3 and 4*. Juno Beach, FL: FPL. January 2018. 762 p. ADAMS Accession No. ML18037A838.

[FPL] Florida Power & Light Company. 2018b. Letter from W. Maher, Senior Licensing Director, to NRC Document Control Desk. Subject: Turkey Point Units 3 and 4 subsequent license renewal application, Appendix E environmental report supplemental information. April 10, 2018. 35 p. ADAMS Accession No. ML18113A132.

[FPL] Entergy Operations, Inc. 2018c. Letter from W. Maher, Senior Licensing Director, to NRC Document Control Desk. Subject: Turkey Point Units 3 and 4 subsequent license renewal application environmental report request for additional information (RAI) responses. August 8, 2018. ADAMS Accession No. ML18247A509.

[FWS] U.S. Fish and Wildlife Service. 1999. *South Florida Multi-Species Recovery Plan*. Atlanta, GA. FWS. 2172 p. Available at <https://www.fws.gov/verobeach/ListedSpeciesMSRP.html#jump4> (accessed August 28, 2018).

[FWS] U.S. Fish and Wildlife Service. 2008. *Carter's mustard* (*Warea carteri*) 5-Year Review: Summary and Evaluation. FWS. September 15, 2008. Available at <https://ecos.fws.gov/docs/five_year_review/doc1977.pdf> (accessed August 30, 2018).

[FWS] U.S. Fish and Wildlife Service. 2010. U.S. Fish and Wildlife Species Assessment and Listing Priority Assignment Form: *Chromolaena frustrata* (Cape Sable Thoroughwort). Washington, DC. ADAMS Accession No. ML14230A018.

[FWS] U.S. Fish and Wildlife Service. 2017. Letter from R. Hinzman, Field Supervisor South Florida Ecological Services Office, FWS to A. Williamson, Project Managers, NRC. Subject: Biological Opinion for Combined License for Turkey Point Nuclear Plant, Units 6 and 7. June 23, 2017. ADAMS Accession No. ML17177A673.

[FWS] U.S. Fish and Wildlife Service. 2018. Letter from South Florida Ecological Services Field Office, FWS. Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project. September 11, 2018. ADAMS Accession No. ML18254A347.

Gann G.D., Stocking C.G., and Collaborators. 2018. Floristic Inventory of South Florida Database Online. The Institute for Regional Conservation. Delray Beach, FL. Available at <<http://regionalconservation.org/ircs/database/database.asp>> (accessed May 28, 2018).

[NRC] U.S. Nuclear Regulatory Commission. 2015. *Biological Assessment for the U.S. Fish and Wildlife Service*, Prepared by the U.S. Nuclear Regulatory Commission and the U.S. Army Corps of Engineers for Florida Power & Light Company Turkey Point Units 6 and 7 Nuclear Project Combined License Application Docket Nos. 052-040 and 052-041 and Permit Application No. SAJ-2009-02417. February 2015. ADAMS Accession No. ML15028A372.

[NRC] U.S. Nuclear Regulatory Commission. 2016. *Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7, Final Report*. Volumes 1, 2, 3, and Supplement 1. Washington, DC. NRC. NUREG-2176. October 31, 2016. 2,092 p. ADAMS Accession Nos. ML16300A104, ML16300A137, ML16300A312, and ML16337A147.

[NRC] U.S. Nuclear Regulatory Commission. 2018. Teleconference Summary between M. Moser, Biologist, NRC and L. Nester, Biologist, FWS. Call held on September 6, 2018. ADAMS Accession No. ML18270A154.

[SFWMD] South Florida Water Management District. 2013. *South Florida Water Management District Patrol Summary, Model Lands October 18–31, 2013*. West Palm Beach, FL. ADAMS Accession No. ML14328A521.