

Biological Assessment

Turkey Point Plant, Units 3 and 4 Proposed Extended Power Uprate

August 2011

Docket Numbers 50-250 and 50-251

**U.S. Nuclear Regulatory Commission
Rockville, Maryland**

Prepared by:

Briana Balsam
Division of License Renewal
Office of Nuclear Reactor Regulation

Table of Contents

1.0 Introduction	4
2.0 Description of the Proposed Action	4
2.1 The Proposed Action	4
2.2 Modifications to Buildings, Infrastructure, and Land	4
2.3 Changes to the Cooling Canal System	5
3.0 Proposed Action Area: Turkey Point Site, Cooling Canal System, Biscayne Bay, and Card Sound	5
3.1 Turkey Point Site	5
3.2 Cooling Canal System	8
3.3 Biscayne Bay and Card Sound	11
4.0 Section 7 Consultation History	12
4.1 Overview	12
4.2 Current Biological Opinion Limits and Conditions	12
5.0 Federally Listed Species Considered	13
5.1 Federally Listed Species That Occur in Miami-Dade County	13
5.2 American Crocodile	15
5.3 American Crocodile Critical Habitat	17
6.0 Proposed Action Effects Analysis	19
6.1 Incidental Takes of American Crocodile	19
6.2 FDEP's Assessment of Proposed Action Effects on the American Crocodile	20
6.3 NRC's Assessment of Proposed Action Effects on the American Crocodile	21
7.0 Cumulative Effects Analysis	24
8.0 Conclusion and Determination of Effects	25
9.0 References	26
9.1 Reference List	26
9.2 Locating References in ADAMS	30
Appendix A	1

Figures

Figure 1. Turkey Point Site and Surrounding 6-mi (10-km) Vicinity	6
Figure 2. Turkey Point Site Layout.....	7
Figure 3. Turkey Point Cooling Canal System.....	9
Figure 4. General Locations of Designated Critical Habitat for the American Crocodile	18
Figure A-1. Water Sample Locations Within the Cooling Canal System, 2009	A-1
Figure A-2. Water Sample Locations Within the Cooling Canal System, 2010	A-2
Figure A-3. Average Cooling Canal Water Temperature, October 2006-September 2009	A-3
Figure A-4. Average Cooling Canal Water Temperature, February 2010-December 2010	103
Figure A-5. Average Cooling Canal Water Salinity, February 2010-December 2010.....	A-4
Figure A-6. Average Cooling Canal Water Salinity, February 2010-December 2010.....	A-4

Tables

Table 1. Temperature and Salinity of Cooling Canal System Features	11
Table 2. Federally Listed Species Occurring in Miami-Dade County	13
Table 3. Summary of 2009 Captured Crocodiles by Size-Class	16
Table 4. Summary of 2010 Captured Crocodiles by Size-Class	17
Table 5. American Crocodile Incidental Takes, 2005-Present	19
Table 6. Location of Crocodiles at Turkey Point by Size-Class	22

Abbreviations, Acronyms, and Symbols

°C	degrees Celsius
°F	degrees Fahrenheit
ΔT	change in temperature
ac	acre
BTU/hr	British thermal units per hour
CFR	<i>Code of Federal Regulations</i>
cm	centimeter
EPU	extended power uprate
ESA	Endangered Species Act
FDEP	Florida Department of Environmental Protection
FPL	Florida Power & Light Co.
FR	Federal Register
ft	foot
FWCC	Florida Fish and Wildlife Conservation Commission
FWS	U.S. Fish and Wildlife Service
gal.	gallon
ha	hectare
hr	hour
in.	inch
km	kilometer
m	meter
m ³	cubic meters
m ³ /day	cubic meters per day
mgd	million gallons per day
mi	mile
MWt	megawatts thermal
NRC	U.S. Nuclear Regulatory Commission
ppt	parts per thousand
SEIS	supplemental environmental impact statement
TL	total length
Turkey Point	Turkey Point Plant, Units 3 and 4

Biological Assessment of the Potential Effects of Turkey Point's Proposed Extended Power Uprate on Federally Listed Species

1.0 Introduction

This biological assessment was prepared to support the U.S. Nuclear Regulatory Commission (NRC)'s review of Florida Power & Light Co. (FPL)'s extended power uprate (EPU) license amendment request dated December 14, 2010, and to comply with the provisions of section 7 of the Endangered Species Act of 1973, as amended (ESA). This biological assessment examines the potential impacts of the Turkey Point Plant, Units 3 and 4 (Turkey Point) on listed species—and specifically the American crocodile (*Crocodylus acutus*)—under EPU conditions.

The NRC and U.S. Fish and Wildlife Service (FWS) have previously consulted under Section 7 of the ESA for Turkey Point. In August 2001, the NRC prepared a biological assessment for the proposed license renewal of Turkey Point. In response to the biological assessment, the FWS determined that the proposed license renewal would not adversely affect any listed species in December 2001. In 2006, NRC initiated formal consultation with the FWS due to the take of an American crocodile. This consultation resulted in a biological opinion regarding the American crocodile in May 2006, which was subsequently modified in August 2006. The 2006 biological opinion for the American crocodile remains in effect today.

2.0 Description of the Proposed Action

2.1 The Proposed Action

The proposed action is NRC's decision whether to approve FPL's license amendment request for an extended power uprate (EPU) at Turkey Point.

FPL submitted a license amendment request to the NRC on December 14, 2010, to increase the maximum thermal power at Turkey Point from 2,300 megawatts-thermal (MWt) to 2,644 MWt, an increase of about 15 percent (FPL 2010a). The NRC considers FPL's proposed uprate to be an EPU. The NRC defines an EPU as an increase in thermal power that is greater than 7 percent and requires significant modifications to major balance-of-plant equipment such as the high pressure turbines, condensate pumps and motors, main generators, and/or transformers (NRC 2011). If approved, the EPU would be effective from the date of NRC approval through the expiration dates of the current renewed licenses (July 19, 2032, for Unit 3 and April 10, 2033, for Unit 4). In its environmental report, FPL (2010b) states that, if approved, it would begin operating at the EPU power level in the Spring of 2012 for Unit 3 and in the Fall of 2012 for Unit 4.

2.2 Modifications to Buildings, Infrastructure, and Land

FPL would implement a number of plant modifications such as changing pipes, valves, pumps, and heat exchangers; replacing the high pressure turbine and condenser; and upgrading switchyard equipment to support the proposed EPU (FPL 2010a). FPL will implement these changes during regular refueling outages and all modifications will be contained within the developed areas of the site. Because none of these activities would disturb natural habitat and the activities are not anticipated to adversely affect any listed species, these modifications are not discussed in any further detail in this biological assessment.

2.3 Changes to the Cooling Canal System

The most relevant change that could adversely affect listed species (and specifically the American crocodile) is the increase in heat load to discharged water entering the cooling canal system. Currently, Turkey Point produces and discharges 10.7 billion British thermal units per hour (BTU/hr) of waste heat to the cooling canal system when both units are operating at full capacity. Under EPU conditions, Turkey Point would discharge 6.10 billion BTU/hr per unit (for a total of 12.2 billion BTU/hr for both units) at full capacity (FPL 2010b). FPL predicts that discharged water would increase a maximum of an additional 2.0 °F (1.1 °C), which would increase the change in temperature (ΔT) as water passes through the condensers from 16.8 °F to 18.8 °F (9.3 to 10.4 °C) (FPL 2010b). Because condenser cooling water discharges at the northeastern corner of the cooling canal system, flows west, and then south, the system exhibits a north-south temperature gradient. Therefore, while the northeast portion of the system may increase by 2.0 °F (1.1 °C) under EPU conditions, the temperature increase attributable to the EPU would decrease as water moves south through the system.

The increased discharge temperatures will cause additional evaporative losses to the cooling canal system. The Florida Department of Environmental Protection (FDEP 2008) predicted that an additional 2 to 3 million gallons per day (mgd) (7,600 to 11,000 cubic meters per day [m^3/day]) will be lost to evaporation under EPU conditions. The increased evaporation would, in turn, increase the cooling canal's salinity by 2 to 3 parts per thousand (ppt) (FDEP 2008). Due to the north-south temperature gradient, evaporative losses would be greater in the northern portion of the canal system, and thus, salinity will also demonstrate a north-south gradient.

3.0 Proposed Action Area: Turkey Point Site, Cooling Canal System, Biscayne Bay, and Card Sound

3.1 Turkey Point Site

Turkey Point is located on a 24,000-ac (9,700-ha) piece of FPL-owned land on the shore of Biscayne Bay about 25 mi (40 km) south-southwest of downtown Miami, Florida, in Miami-Dade County. The nearest towns are Florida City, which is 8 mi (13 km) west of the site, and Homestead, which is 9 mi (14 km) northwest of the site. Turkey Point shares its site with a two-unit fossil fuel plant, and a one-unit natural gas-fired combined cycle plant, both of which are also owned by FPL. The non-nuclear units are not regulated or licensed by the NRC.

The shore of the Turkey Point site, as well as several miles of shoreline north of the plant, comprise Biscayne National Park. Mangrove Point, located south of the Turkey Point site, divides Biscayne Bay from Card Sound. The site is situated on low, swampy land that was previously mangrove-covered tidal flats. Mangrove swamps extend inland approximately 3 to 4 mi (5 to 6.5 km), and undeveloped portions of the site remain under 1 to 3 in. (2 to 8 cm) of water, even during low tide. Site terrain is flat and rises gently from sea level at the shore to about 10 ft (3 m) above mean sea level in Homestead. The site itself is typically less than 0.3 m (1 ft) above mean sea level. Across Biscayne Bay, about 5 to 8 mi (8 to 13 km) east, is a series of offshore barrier islands with a northeast-southwest orientation between the bay and the Atlantic Ocean. Figure 1 shows the site location and features within 6 mi (10 km), and Figure 2 is a layout of the site.

Figure 1. Turkey Point Site and Surrounding 6-mi (10-km) Vicinity

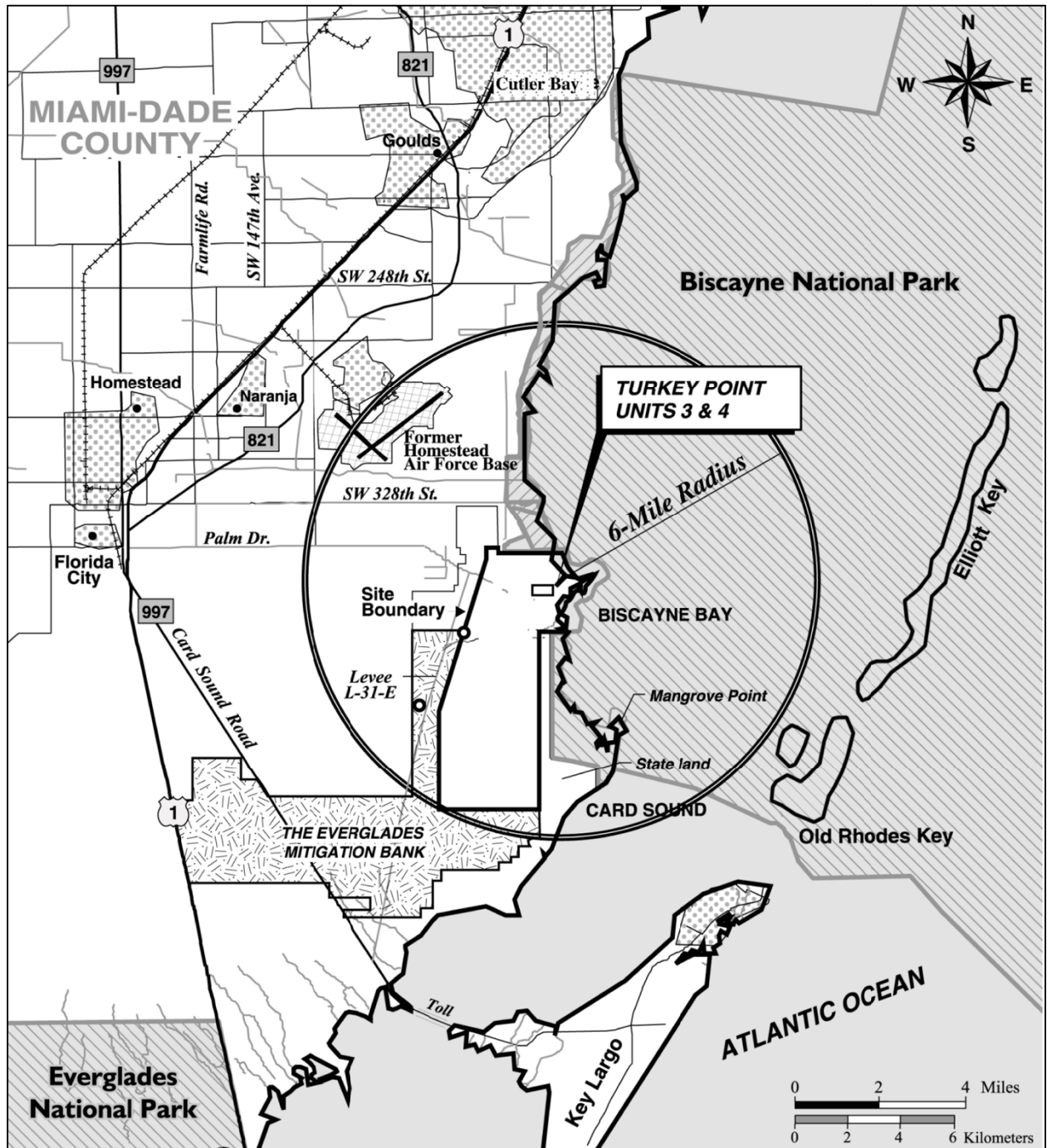


Image Source: FPL 2010b

Figure 2. Turkey Point Site Layout

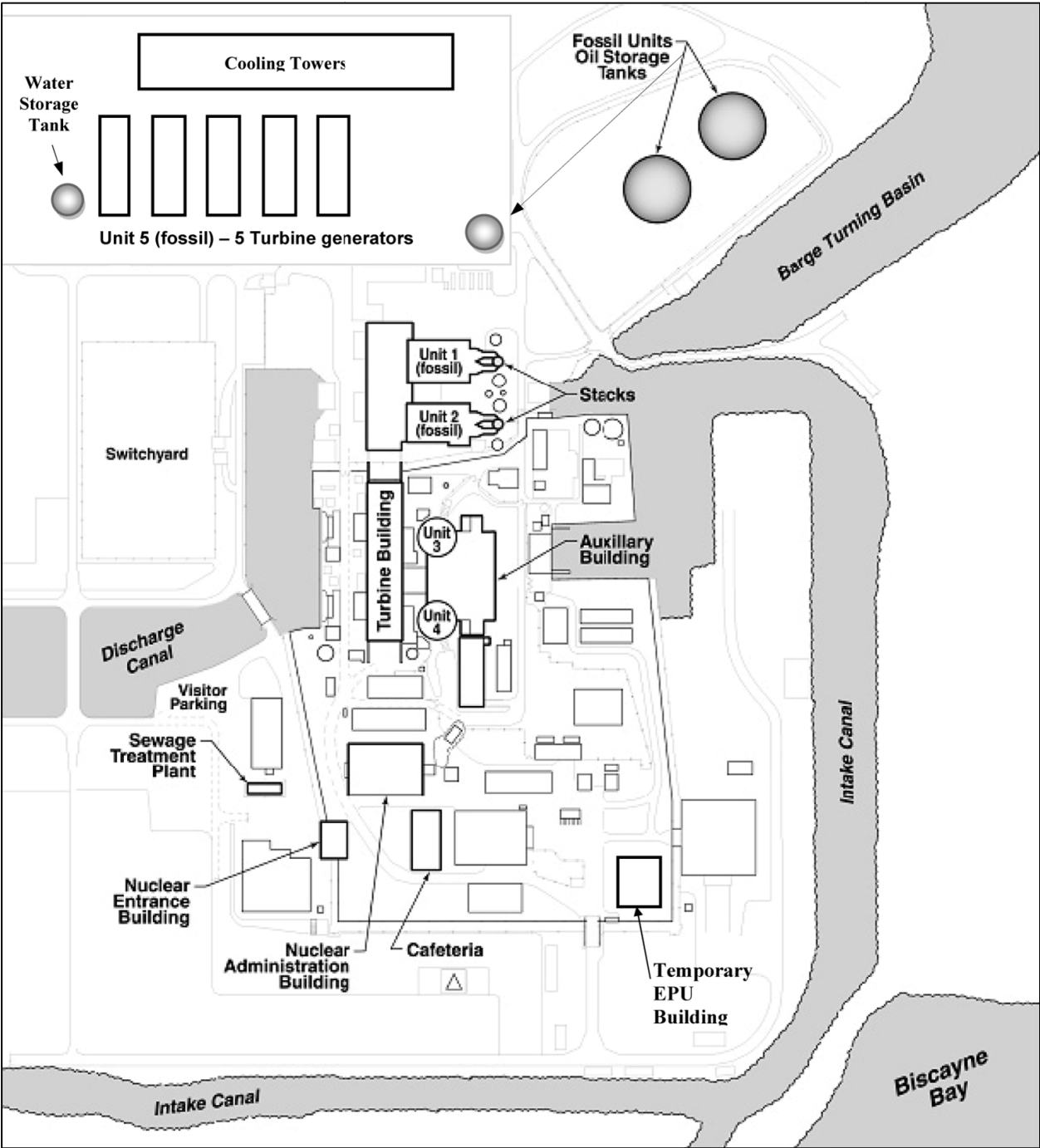


Image Source: FPL 2010b

The NRC published a final facility-specific supplemental environmental impact statement (SEIS) to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437 (NRC 1996), for the Turkey Point license renewal in 2002. Chapter 2 of the SEIS (NRC 2002) includes a more detailed description of the site location and features.

3.2 Cooling Canal System

Overview

Turkey Point uses three cooling water loops for heat dissipation. The primary and secondary loops are closed systems that use treated freshwater to remove heat from the reactors and steam generators. Turkey Point obtains water for these loops from the Newton water-treatment plant, part of the Miami-Dade public water supply system. The third loop is the circulating water system, which cools the secondary loop by non-contact cooling. The circulating water system withdraws saltwater from and discharges heated effluent water to a closed cooling canal system.

The cooling canal system dissipates heat from Turkey Point as well as the neighboring FPL-owned, 2-unit fossil fuel facility. FPL constructed the Turkey Point cooling canal system in agreement with the U.S. Environmental Protection Agency and the State of Florida to mitigate environmental impacts to Biscayne Bay and Card Sound. Figure 3 provides a schematic of the cooling canal system. The cooling canal system lies adjacent to Biscayne Bay and Card Sound. An interceptor ditch, which enables FPL to restrict groundwater from seeping inland from the cooling canal system, lies along the northwest and west sides of the cooling canal system. The cooling canal system is manmade system that is wholly FPL-owned and operated.

The cooling canal system spans about 5,900 ac (2,400 ha) spread over a 5 mi by 2 mi (8 km by 3.2 km) area (FPL 2011). As Turkey Point discharges heated water, water disperses into 32 feeder channels that travel south from the plant and ultimately discharge into a single collector canal. The collector canal feeds water into six return channels that carry water north and then return that water to the plant for reuse. Each channel is about 200 ft (60 m) wide and has a water depth of 1 to 3 ft (0.3 to 1 m) (FPL 2011). Channels are separated from one another by 27-m (90-ft)-wide berms that rise approximately 7.8 ft (2.3 m) above mean low water (FPL 2011). In all, the combined length of all channels is about 168 mi (270 km), and the effective water surface area is about 3,860 ac (1,560 ha) (NRC 2002). FPL attributes about 82 m³/s (1.3 million gpm) of flow through the canals to the Turkey Point nuclear units (NRC 2002). Additional flow results from the neighboring fossil-fuel facility.

FPL does not supply makeup water to the cooling canal system. Rather, rainfall; storm runoff; treated process wastewater from the plant's municipal supply; and groundwater inflow even out evaporative losses. Evaporative cooling in the canal system results in water with a much higher saline content (about 40 to 60 ppt) in the canal system than the neighboring Biscayne Bay (24 to 40 ppt) (FPL 2010b).

A number of the ecological studies performed at Turkey Point have characterized the various cooling system ditches and canals by temperature, salinity, and any unique features. The cooling canal system features identified in Figure 3 are summarized in detail below. Table 1 lists the temperature and salinity ranges and means for each cooling canal system feature.

Figure 3. Turkey Point Cooling Canal System

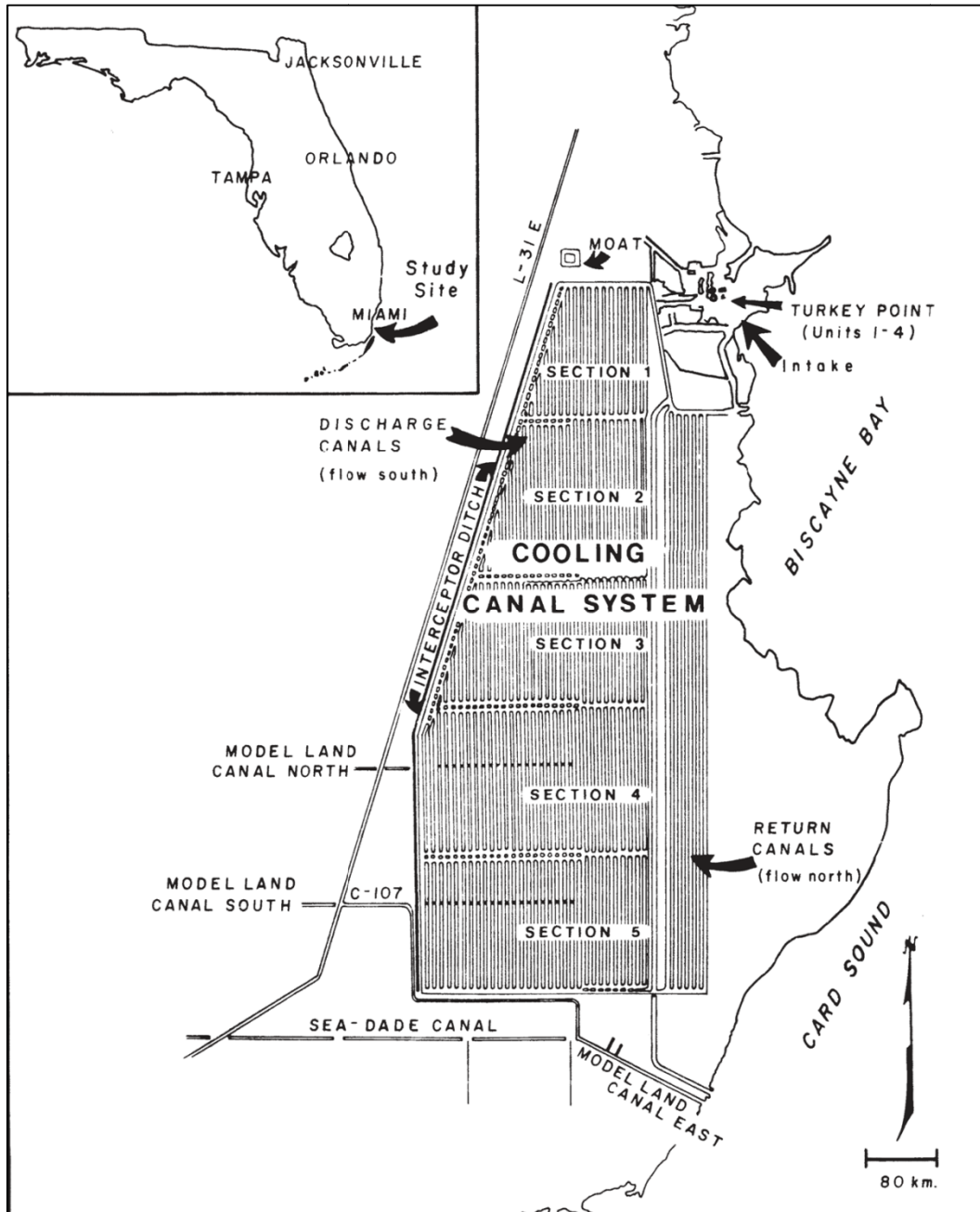


Image Source: Gaby et al. 1985

Cooling Canals

The cooling canals are separate by berms (described above) that include barren areas with little vegetation; areas dominated by salt marsh species, including *Salicornia* spp., *Sesuvium* spp., and *Batis* spp.; and forested areas that support Australian pine (*Casaurina* spp.), Brazilian pepper (*Schinus terebinthifolius*), red mangrove (*Rhizophora mangle*), and buttonwood (*Conocarpus erectus*). Earlier successional areas include sawgrass (*Cladium jamaicensis*), swamp fern (*Blechnum serrulatum*), and saltbush (*Baccharis* spp.). (Gaby et al. 1985)

As part of their crocodile management plan, FPL created freshwater pools on top of the cooling canal berms, which act as refugia for hatchlings and juvenile crocodiles. The system supports a variety of aquatic species typical of shallow, subtropical, hypersaline environments, including phytoplankton, zooplankton, marine algae, rooted plants, crabs, and estuarine fish. The most abundant fish in the cooling canal system is killifish (Family Cyprinodontidae) (FPL 2000). Game species, including common snook (*Centropomus undecimalis*) and tarpon (*Megalops atlanticus*) are also relatively common (FPL 2000).

Moat

The moat, located at the northwest corner of the cooling canals, contains a series of 4.4-m-deep and 12-m-wide canals with low, flat banks covered in red mangrove, buttonwood, sawgrass, and cattail (*Typha latifolia*) (Mazzotti and Cherkiss 2003).

Interceptor Ditch

The interceptor ditch has 3-m-high banks of limestone rock fill. The majority of the bank is barren, though some areas are vegetated with Australian pine. (Gaby et al. 1985)

From May to October, groundwater naturally flows southeasterly away from land and towards Biscayne Bay and Card Sound. However, from November to April, groundwater flow can reverse and flow inland. Under reverse groundwater flow conditions, FPL pumps water from the interceptor ditch back into the cooling canal system to create an artificial gradient and prevent groundwater seepage from adversely affecting freshwater habitats west of the site. The interceptor ditch is not hydraulically connected to either the cooling canals or other surface waters; therefore, the only inflow is via groundwater seepage into the ditch. FPL regularly monitors water levels in the cooling canal system, interceptor ditch, and in four groundwater-monitoring wells on the site. Generally, FPL pumps about 216 million gal. (818,000 m³) of water per year from the interceptor ditch into the cooling canal system. FPL operates the interceptor ditch in accordance with an agreement with the South Florida Management District. (FPL 2011)

L-31E Borrow Canal

This canal has flat banks with sawgrass, spike rush (*Eleocharis cellulosa*), and cattail (Gaby et al. 1985).

Model Land Canals North and South

These canals are part of the cooling canals and have similar vegetation as that described above under “Cooling Canals.”

C-107 Canal

This canal is characterized by red mangrove along the north-south segment and sawgrass and Australian pine along the remainder of the length (Gaby et al. 1985).

Model Land Canal East

This canal empties into Card Sound. The northern bank, which is steep and about 1.5-m high, contains Australian pine. The southern bank is relatively flat and is covered in red mangrove. The canal is an average of 3.9 m deep and 20 m wide. (Gaby et al. 1985)

Sea Dade Canal

This canal is divided into three 0.8-km sections. The northern bank contains a thin strip of red mangrove, behind which Australian pine and buttonwood occur. The southern bank is flatter and contains red mangrove, sawgrass, and saltgrass (*Distichlis spicata*). This canal is 3.8 m deep and 10 m wide. (Gaby et al. 1985)

Table 1. Temperature and Salinity of Cooling Canal System Features

Cooling Canal System Feature	Temperature Range (in °C (°F))	Mean Temperature (in °C (°F))	Salinity Range (in ppt)	Mean Salinity (in ppt)
Cooling canals (including model land canals north and south)	14-42 (57.2-107.6)	30.4 (86.7)	0-46	36.5
Moat	16.0-32.5 (60.8-90.5)	30.3 (86.5)	0-4	1.2
Interceptor ditch	14.0-34.5 (57.2-94.1)	27.1 (80.8)	0-14	5.6
L-31E borrow canal	18.0-39.8 (64.4-103.6)	27.2 (81.0)	0-2	0.45
C-107 canal	16.0-33.0 (60.8-91.4)	27.3 (81.1)	0-39	15.8
Model land canal east	20.0-33.0 (68-91.4)	27.4 (81.3)	0-38	20.7
Sea Dade Canal	15.5-35.7 (59.9-96.3)	27.4 (81.3)	0-32	15.4

Source: Mazzotti and Cherkiss 2003

3.3 Biscayne Bay and Card Sound

Biscayne Bay and Card Sound are shallow, subtropical marine waters located between the mainland and a grouping of barrier islands that form the northern-most Florida Keys. These waters contain a rich variety of marine life, including seagrasses, sponges, mollusks, crustaceans, fish, sea turtles, and marine mammals. The portion of Biscayne Bay adjacent to Turkey Point is part of Biscayne National Park, which includes the mainland shore, the bay, the keys, and offshore coral reefs. The Intracoastal Waterway traverses Biscayne Bay and Card Sound, and a barge passage runs from the Intracoastal Waterway to the fossil-fueled facility at the Turkey Point site. The bay and sound have been well studied over the last four decades by J.K. McNulty, R.A. Roessler, R.G. Bader, and others.

Important species and habitats in Biscayne Bay and Card Sound include the mangrove forest along the shoreline, which is one of the longest continuous stretches of mangroves left on the east coast of Florida. Seagrass beds are also an important feature

and provide refuge for approximately 70 percent of the area's recreationally and commercially important marine species, which include tarpon, snook (*Centropomus* spp.), red drum (redfish) (*Sciaenops ocellatus*), permit (*Trachinotus falcatus*), and sea trout (*Cynoscion* spp.) (Cantillo et al., 2000). Seagrass beds provide forage for sea turtles and the West Indian manatee (*Trichechus manatus*). Common seagrass species include shoal grass (*Halodule wrightii*), turtle-grass (*Thalassia testudinum*), and manatee-grass (*Syringodium filiforme*). Biscayne Bay and Card Sound are also nursery areas for the spiny lobster (*Panulirus argus*).

4.0 Section 7 Consultation History

4.1 Overview

NRC first initiated section 7 consultation with FWS regarding Turkey Point in 2001 as part of the Turkey Point license renewal review. During this consultation, NRC staff considered the potential adverse effects on 23 Federally listed species in its biological assessment (NRC 2001). In the 2001 biological assessment, the NRC concluded that license renewal would have no effect or would not be likely to adversely affect any listed species. In December 2001, the FWS determined that the proposed license renewal would not adversely affect any listed species (FWS 2001).

In 2006, the NRC requested to initiate formal consultation for ongoing operation of Turkey Point after a juvenile American crocodile was hit with a vehicle on the Turkey Point site (NRC 2006a). The American crocodile was the only species considered during this consultation. As a result of the consultation, the FWS issued a biological opinion in May 2006 (FWS 2006a), which was subsequently modified in August 2006 (FWS 2006a). The 2006 biological opinion for the American crocodile remains in effect today and is discussed in more detail in the following sections.

4.2 Current Biological Opinion Limits and Conditions

FWS modified the May 5, 2006, biological opinion (FWS 2006a)'s incidental take statement on August 1, 2006 (FWS 2006b) to allow Turkey Point to incidentally take up to:

- Two American crocodiles from May 5, 2006, through May 4, 2011, and
- One American crocodile per year thereafter.

The biological opinion and subsequent modifications also contain the following terms and conditions to increase awareness of the American crocodile on the site:

- (1) FPL must install four warning signs for crocodile crossings along Bechtel Road.
- (2) FPL must install 5-MPH speed limit signs along Bechtel Road.
- (3) FPL must provide an informational bulletin about the American crocodile to employees every six months.
- (4) FPL must conduct a presentation on the American crocodile twice per year at all-hands monthly safety meetings.
- (5) FPL must report dead or injured crocodiles to the FWS Law Enforcement Office and South Regional Office.

5.0 Federally Listed Species Considered

5.1 Federally Listed Species That Occur in Miami-Dade County

Because all activities associated with the proposed EPU would occur on the Turkey Point site in Miami-Dade County, the NRC staff considered all listed species occurring in this county. Table 2 lists the 31 species that potentially occur on or near the Turkey Point site.

Table 2. Federally Listed Species Occurring in Miami-Dade County

Scientific Name	Common Name	ESA Status ^(a)
Aquatic Invertebrates		
<i>Acropora cervicornis</i>	staghorn coral	PT
<i>Acropora palmate</i>	elkhorn coral	PT
Birds		
<i>Ammodramus maritimus mirabilis</i>	Cape Sable seaside sparrow	E
<i>Charadrius melodus</i>	piping plover	T
<i>Dendroica kirtlandii</i>	Kirtland's warbler ^(b)	E
<i>Mycteria americana</i>	wood stork	E
<i>Polyborus plancus audubonii</i>	Audubon's crested caracara ^(b)	T
<i>Rostrhamus sociabilis plumbeus</i>	Everglade snail kite	E
<i>Vermivora bachmanii</i>	Bachman's warbler ^(b)	E
Fish		
<i>Pristis pectinata</i>	smalltooth sawfish	E
Insects		
<i>Heraclides aristodemus ponceanus</i>	schaus swallowtail butterfly	E
Mammals		
<i>Puma concolor</i>	mountain lion ^(b)	T/SA
<i>Felis concolor coryi</i>	Florida panther	E
<i>Trichechus manatus</i>	West Indian manatee	E
Plants		
<i>Amorpha crenulata</i>	crenulate lead-plant	E
<i>Chamaesyce deltoidea</i> ssp. <i>deltoidea</i>	deltoid spurge	E
<i>Chamaesyce garberi</i>	Garber's spurge	T
<i>Cucurbita okeechobeensis</i> ssp. <i>okeechobeensis</i>	okeechobee gourd ^(b)	E
<i>Galactia smallii</i>	Small's milkpea	E
<i>Halophia johnsonii</i>	Johnson's sea grass	T

**Table 2. Federally Listed Species Occurring in Miami-Dade County
(continued)**

Scientific Name	Common Name	ESA Status ^(a)
<i>Jacquemontia reclinata</i>	beach jacquemontia	E
<i>Polygala smallii</i>	tiny polygala	E
Reptiles		
<i>Alligator mississippiensis</i>	American alligator	T/SA
<i>Caretta caretta</i>	loggerhead sea turtle	T
<i>Chelonia mydas</i>	green sea turtle	E
<i>Crocodylus acutus</i>	American crocodile	T
<i>Dermochelys coriacea</i>	leatherback sea turtle	E
<i>Drymarchon corais couperi</i>	eastern indigo snake	T
<i>Eretmochelys imbricata</i>	hawksbill sea turtle	E
<i>Lepidochelys kempii</i>	Kemp's ridley sea turtle ^(c)	E
Snails		
<i>Orthalicus reses</i>	Stock Island tree snail ^(b)	T

^(a)E = endangered; PT = proposed threatened; T = threatened; T/SA = threatened due to similarity of appearance

^(b)Species not previously considered in 2001 biological assessment for Turkey Point.

^(c)The Kemp's ridley is not listed by the FWS as occurring in Miami-Dade County. However, the species occurs in the neighboring Monroe County and FPL (2011) has reported the species' occurrence in Biscayne Bay and Card Sound.

Source: FWS 2010, 2011

Of the listed species included in Table 2, FPL (2011) reported that the wood stork (*Mycteria americana*), West Indian manatee (*Trichechus manatus*), the five species of sea turtles, eastern indigo snake (*Drymarchon corais couperi*), and American crocodile occur or have been seen on the site.

Within terrestrial or freshwater wetland habitats, FPL (2011) reported that the wood stock occasionally occurs in the industrial wastewater facility on the site and near the proposed Turkey Point, Units 6 and 7, laydown area. The eastern indigo snake has been seen onsite twice: in 2004, south of the industrial wastewater facility in the Everglades Mitigation Bank, and in 1981, adjacent to the FPL daycare facility (FPL 2011). Neither of these species would be adversely affected by the proposed EPU because all construction activities would occur on previously disturbed areas of the site. The industrial wastewater facility, where both of these species have been observed, would not be affected by the proposed EPU.

West Indian manatees occur in Biscayne Bay and Card Sound, where critical habitat is also designated for this species. The five listed sea turtles also occur in Biscayne Bay and Card Sound. No suitable nesting habitat for sea turtles occurs on the site, but the sea turtles use the bay and sound for foraging. The loggerhead (*Caretta caretta*) is the most common sea turtle in the vicinity of the plant (FPL 2011). Because the proposed

EPU would not affect the bay or sound, none of these species would be adversely affected by the proposed action. The cooling canal system, which would experience an increase in temperature and salinity, is a closed system and is not accessible to aquatic species from any natural water body, including Biscayne Bay and Card Sound. Therefore, the changes to the cooling canal system environment discussed in Section 2.3 would not affect these species.

A resident population of American crocodile inhabits the Turkey Point cooling canal system, and FWS has designated critical habitat for this species that includes areas on the Turkey Point site. Because the proposed EPU would increase the temperature and salinity of the cooling canal system's water, the American crocodile could be adversely affected; therefore, this species will be considered in more detail in the following sections.

5.2 American Crocodile

The description, distribution, and habitat of the American crocodile has been previously documented in the NRC's 2001 biological assessment as well as FWS's 2006 biological opinion. Many of the references (Gaby et al. 1985; Kushlan and Mazzotti 1989; Mazzotti 1983; Mazzotti and Cherkiss 2003; Mazzotti et al. 1986, 2007) also provide detailed life history information on the American crocodile. Therefore, this section will only discuss newly available information (since the issuance of the 2006 biological opinion) concerning crocodiles on the Turkey Point site.

Changes to the Species' Listing Status

The FWS initially listed the American crocodile as endangered throughout its range in 1979 (44 FR 75074). In 2007, the FWS reclassified the Florida population as a threatened distinct population segment due to the population's growth and distribution expansion since 1975 (72 FR 13027). The FWS estimated the population to be between 1,400 and 2,000 individuals (excluding hatchlings) at the time the reclassification listing was published in 2007 (72 FR 13027). The South Florida Ecological Office manages the recovery of the Florida population as part of the South Florida Multi-Species Recovery Plan (FWS 2007).

American Crocodile Monitoring Program at Turkey Point

As part of Turkey Point's Site Certification (described in more detail in Section 6.2), the FDEP conditioned FPL to initiate an American crocodile monitoring program and to report the results of this program annually. FPL began monitoring in October 2008, and has since issued two annual reports (Mazzotti et al. 2009, 2010). The purpose of the monitoring program is to determine whether the proposed EPU, if implemented, negatively affects the species.

The monitoring program objectives are to:

- (1) determine growth and survival rates of crocodiles at Turkey Point, and
- (2) determine crocodile use (spatial patterns) of the cooling canal system in relation to temperature and salinity.

To gather this information, Mazzotti et al. (2009, 2010) captured crocodiles during planned capture events to record individuals' measurements and weight and conducted spotlight surveys to determine spatial distribution. Mazzotti et al. (2009, 2010) recorded cooling canal water temperature and salinity using dataloggers at set locations within the canal system. Appendix A to this biological assessment contains figures depicting the

canal water temperature and salinity variations by month for the 2009 and 2010 data years.

2009 Monitoring Report Summary

In 2009, Mazzotti et al. conducted two capture events (one in January and one in May). For those individuals that had been previously captured and whose measurements had been recorded at Turkey Point, Mazzotti et al. calculated change in total length (TL) and mass. Table 3 summarizes the average changes in TL and mass by size-class. Overall, growth rate ranged from -0.02 to 0.28 cm/day (-0.008 to 0.11 in/day), and change in mass ranged from -8.66 to 25.58 g/day (-0.305 to 0.902 oz/day). Mazzotti et al. also calculated hatchling first year survival, which ranged from 1 to 6 percent.

Mazzotti et al. conducted monthly spotlight surveys between October 1, 2008, and September 30, 2009, during which time 1,309 crocodile observations were made. Mazzotti et al. (2009)'s regression analysis indicated that the density of crocodile observations decreased as water temperature increased. Juveniles, however, showed an increase in observations with an increase in water temperature. Mazzotti et al. (2009) also found that crocodiles change their core use area within the cooling canal system throughout the year. Crocodile observations were most concentrated in the southeast corner of the canal system throughout the majority of survey months, but crocodile observations were more spread out throughout the canal system during breeding season.

Table 3. Summary of 2009 Captured Crocodiles by Size-Class

Size-class	Range in TL^(a) in m^(b)	Number Captured^(b)	Percent of Total Captures^(b)	Average Change in TL Between Recaptures (cm/day)^(c)	Average Change in Mass Between Recaptures (g/day)^(c)
young of year	<0.65	15	13	8.8	1.01
juveniles	0.65 to <1.5	76	66	7.7	2.51
subadults	1.5 to <2.25	19	16	5.3	6.82
adults	≥2.25	6	5	4.0	23.82

^(a)TL=total length

^(b)Source: Mazzotti et al. 2009

^(c)Calculated values based on Mazzotti et al. 2009 data

2010 Monitoring Report Summary

In 2010, Mazzotti et al. conducted capture events and spotlight events as described above. The capture events were in January, May, and November, and the spotlight surveys were conducted monthly between February 23, 2010, and December 9, 2010. Table 4 summarizes the 180 captured individuals by size-class. The results of the spotlight surveys were consistent with those discussed for the 2009 monitoring report.

Table 4. Summary of 2010 Captured Crocodiles by Size-Class

Size-class	Range in TL ^(a) in m ^(b)	Number Captured ^(b)	Percent of Total Captures ^(b)	Average Change in TL Between Recaptures (cm/day) ^(c)	Average Change in Mass Between Recaptures (g/day) ^(c)
young of year	<0.65	53	29	11.1	1.58
juveniles	0.65 to <1.5	85	47	9.8	4.56
subadults	1.5 to <2.25	30	17	5.6	6.73
adults	≥2.25	12	7	3.8	18.7

^(a)TL=total length

^(b)Source: Mazzotti et al. 2010

^(c)Calculated values based on Mazzotti et al. 2010 data

5.3 American Crocodile Critical Habitat

The FWS designated critical habitat for the American crocodile in Florida as the following (50 CFR 17.95(c)):

All land and water within the following boundary: Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; thence Northwestward along a straight line to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

Figure 4 shows the general region of designated critical habitat. Within the region designated as critical habitat by FWS, only the areas that contain “primary constituent elements” (the physical and biological landscape features that are required for a species to survive and reproduce) are considered critical habitat (FWS 2000b). Therefore, buildings, marinas, parking lots, and other manmade or developed areas do not constitute critical habitat.

The majority of the Turkey Point site, including the cooling canal system, is within the region of designated American crocodile critical habitat. The proposed EPU would only affect previously developed areas of the site and the cooling canal system (a manmade water feature). The cooling canal system is the only affected area that contains primary constituent elements (as defined above) that support the American crocodile. Therefore, the only critical habitat potentially affected by the proposed EPU is that of the cooling canal system. Section 3.2 describes the cooling canal system features and typical vegetation.

Figure 4. General Locations of Designated Critical Habitat for the American Crocodile

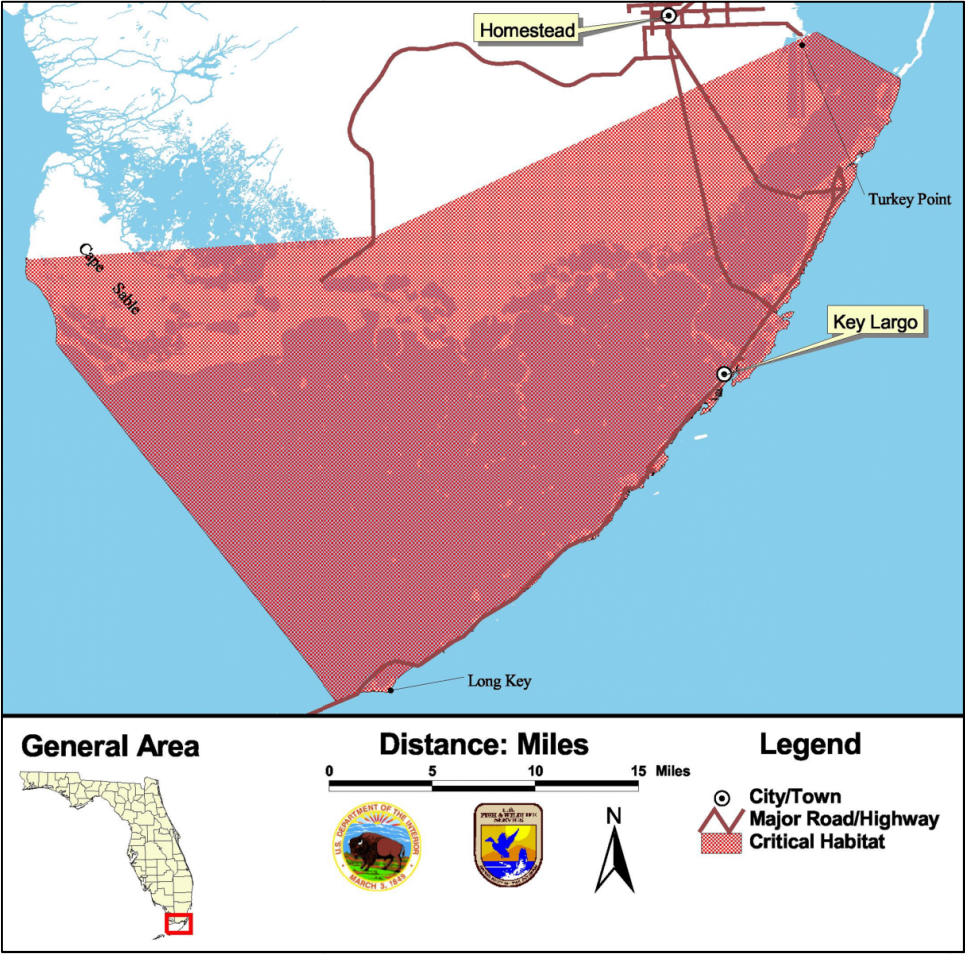


Image Source: FWS 2000a

6.0 Proposed Action Effects Analysis

6.1 Incidental Takes of American Crocodile

Since 2005, FPL has reported 12 American crocodile deaths. Of these, FPL attributes two deaths to Turkey Point operations or activities. Table 5 summarizes American crocodile incidental takes starting with the December 21, 2005, incident, which was the initiating event for the 2006 formal section 7 consultation between FWS and NRC.

Table 5. American Crocodile Incidental Takes, 2005-Present

Date	Age of Individual	Incident Description	Cause of Death	Attributable to Plant Operations?^(a)	Reference
12/21/05	juvenile	Individual struck and killed by vehicle on road south of test canals	Vehicle collision	Yes	NRC 2006a
5/27/06	subadult	Individual struck and killed by security vehicle on patrol of cooling canals	Vehicle collision	Yes	NRC 2006b
9/24/07	juvenile	Deceased individual found in freshwater pond south of cooling canal system	Not specifically attributed to a cause, but report mentions water in lungs and parasites in stomach	No	NRC 2007
1/9/08	unspecified	Deceased individual found in cooling canal system	Determined to be due to respiratory infection	No	NRC 2008a
7/29/08	unspecified	Deceased individual found in interceptor ditch	Determined to be due to natural causes	No	NRC 2008b
9/25/08	hatchling	Deceased individual found on site	Determined to be caused by vehicle collision and then moved to point of discovery by a vulture	No	NRC 2008c
1/28/10	unspecified	Deceased individual found in wetlands near cooling towers	No signs of physical trauma; determined to be due to cold weather	No	NRC 2010a

**Table 5. American Crocodile Incidental Takes, 2005-Present
(continued)**

Date	Age of Individual	Incident Description	Cause of Death	Attributable to Plant Operations?^(a)	Reference
3/9/10	unspecified	Deceased individual found floating in interceptor ditch	Carcass was moderately decomposed with no sign of physical trauma	No	NRC 2010b
12/26/10	juvenile	Deceased individual found in screen wash system trash basket	Carcass was moderately decomposed with physical trauma attributable to natural causes	No	NRC 2010c
12/27/10	unspecified	Deceased individual found in interceptor ditch	Carcass exhibited trauma attributable to natural causes	No	NRC 2010d
1/12/11	unspecified	Deceased individual found in interceptor ditch	Carcass exhibited trauma attributable to natural causes	No	NRC 2011a
7/21/11	unspecified	Deceased individual found in the Unit 4 intake	No information provided	No	NRC 2011b

^(a)Causality of incidental takes in this table reflects that which was reported by FPL in required 4-hour notifications to the NRC. NRC has not made any independent determinations as to the cause of any American crocodile takes at Turkey Point.

6.2 FDEP's Assessment of Proposed Action Effects on the American Crocodile

The EPU could adversely affect the American crocodile primarily by increasing the temperature of discharged water, and subsequently, increasing the salinity of the water in the cooling canal system through increased evaporation.

Previous to submitting a license amendment request to the NRC, FPL applied to the FDEP to amend Turkey Point's Site Certification in June 2009. Certifications fall under the Power Plant Siting Act (Fl Stat. 403.501-518), which is the State of Florida's centralized process for licensing large power plants. As part of this certification process, the FDEP receives input and recommendations from other state agencies, including the Florida Fish and Wildlife Conservation Commission (FWCC), to ensure compliance with all applicable statutory and administrative requirements and to aid in determining Conditions of Certification, which are the licensing requirements for the facility. During this review process, the FWCC provided an agency report (FWCC 2008) that included potential effects to the American crocodile. This report was based, in part, on input from J. Perran Ross (2008), an expert on crocodilian biology at the University of Florida.

In their agency report, FWCC (2008) made four main conclusions, which are summarized below.

1. Increased temperatures would reduce the available habitat for adult crocodiles and would displace crocodiles lower in the social hierarchy.
2. Increased temperatures would reduce available habitat for and could reduce the survival of hatchlings because hatchlings are less able to behaviorally thermo-regulate and are less tolerant of extreme temperatures.
3. Increased salinity is unlikely to alter adult crocodiles' ability to survive and reproduce.
4. Increased salinity should have little effect on hatchling crocodiles as long as they continue to have access to the freshwater that accumulates at the top of berms within the canal system.

As part of their report, the FWCC also recommended a number of conditions regarding crocodile monitoring, which the FDEP incorporated into the final Conditions of Certification (FDEP 2009). The monitoring conditions include pre- and post-EPU monitoring to determine any changes to the growth, survival, or reproductive success of the crocodile population as a result of the EPU. If monitoring reveals any negative effects, the Conditions of Certification require FPL to implement corrective actions for the protection of the American crocodile (FDEP 2009).

6.3 NRC's Assessment of Proposed Action Effects on the American Crocodile

The NRC staff generally adopts the FWCC's conclusions regarding impacts to crocodiles resulting from the proposed EPU. This section discusses each FWCC conclusion listed in Section 6.2 based on information in FPL (2010b)'s environmental report, scientific literature, and other available data.

Increased temperatures would reduce the available habitat for adult crocodiles and would displace crocodiles lower in the social hierarchy.

Crocodilian species prefer temperatures from 30 to 35 °C (86 to 95 °F) (Mazzotti et al. 1986). Ross (2008) indicated that crocodilians have an even more limited preferred range of 28 to 31 °C (82.4 to 87.8 °F). Both Mazzotti et al. (1986) and Ross (2008) note that temperatures above 35 °C (95 °F) are lethal. Turkey Point's cooling canal system ranges in temperature from 14 to 42 °C (57.2 to 107.6 °F) annually with a mean of 30.4 °C (86.7 °F) (Mazzotti and Cherkiss 2003). Generally, the northern portion of the cooling canal system is the highest in temperature because the heated discharge flows north to south through the canal system. FPL's 2009 and 2010 annual American crocodile monitoring reports (Mazzotti et al. 2009, 2010) indicate that the majority of the cooling canal system exceeds 35 °C (95 °F) from May through September. Appendix A to this biological assessment contains figures depicting the seasonal temperature fluctuations reported in the 2009 and 2010 crocodile monitoring reports.

Under EPU conditions, the discharged water would be about 2.0 °F (1.1 °C) higher in temperature (FPL 2010b). This increase in temperature would reduce the suitable habitat for crocodiles, especially during the months of May through September. Because crocodiles form complex social hierarchies, a reduction in available habitat will create more competition for the remaining suitable habitat and will likely displace crocodiles lower in the hierarchy (Ross 2008). Displacement could, in turn, affect adult crocodiles' reproductive success and result in reduced population growth.

Increased temperatures would reduce available habitat for and could reduce the survival of hatchlings because hatchlings are less able to behaviorally thermoregulate and are less tolerant of extreme temperatures.

The effects of increased temperatures on hatchling crocodiles would be similar to those discussed above, but would likely be greater in magnitude than those effects on juvenile and adult crocodiles because hatchlings are less able to behaviorally thermoregulate. Mazzotti et al. (1986) found that elevated temperatures (>40 °C [104 °F]) or higher salinities (40 ppt) cause hatchlings to reduce their food intake. Mazzotti et al. (1986) noted that the temperatures in the Turkey Point cooling canal system are high enough to already be stressful to hatchling crocodiles. Because the temperature of water would increase an additional 2.0 °F (1.1 °C) under EPU conditions and the highest canal system temperatures occur when nests are hatching, decreased survivorship or growth of hatchlings may result. The increased temperatures could also render previously suitable nesting habitat unviable.

Increased salinity is unlikely to alter adult crocodiles' ability to survive and reproduce.

A number of studies (Dunson 1970, 1980, 1982; Ellis 1981; Evans and Ellis 1977; Mazzotti 1983) have suggested that salinity is a key factor in crocodile habitat preference. Gaby et al. (1985) studied the population ecology of American crocodiles at Turkey Point, specifically, and found that habitat preference varies by size-class. Gaby et al. (1985) observed the majority (83 percent) of adult crocodiles in the interceptor ditch, and the majority of subadults in the Sea Dade Canal. More juveniles occurred in the Model Land Canal South, though juveniles were more evenly distributed throughout the cooling canal system, interceptor ditch, Model Land Canal East, Sea Dade Canal, and other aquatic features than other size-classes. Table 6 combines size-class habitat preferences reported by Gaby et al. (1985) with the temperature and salinity ranges reported by Mazzotti and Cherkiss (2003). Mean temperatures remain similar in preferred locations of each size-class, while salinity varies, which implies that salinity is more of a determining factor in size-class habitat preference than temperature.

Table 6. Location of Crocodiles at Turkey Point by Size-Class

Size-class	Most Frequently Observed Location	Location Temperature Range	Location Mean Temperature (in °C (°F))	Location Salinity Range (in ppt)	Location Mean Salinity (in ppt)
Juveniles	Model Land Canal South	20.0-33.0 (68.0-91.4)	27.4 (81.3)	0-38	20.7
Subadults	Sea Dade Canal	15.5-35.7 (59.9-96.3)	27.4 (81.3)	0-32	15.4
Adults	interceptor ditch	14.0-34.5 (57.2-94.1)	27.1 (80.8)	0-14	5.6

Sources: Gaby et al. 1985, Mazzotti and Cherkiss 2003

Salinity of the cooling canal system water—and not that of the other aquatic features on the site depicted in Figure 3—would increase under EPU conditions, which means that the preferred aquatic habitat for all size-classes would remain unchanged. Juveniles and

subadults would be most affected by the increased salinity because Gaby et al. (1985) observed 27 percent of juvenile and subadults in the cooling canal system. In FPL's 2009 and 2010 annual American crocodile monitoring reports, Mazzotti et al. (2009, 2010) reported that the majority of crocodiles of all size-classes occurred in the southern portion of the cooling canal system during monthly spotlight surveys. The southern portion of the canal system is likely to experience the lowest increase in salinity under EPU conditions, which indicates that crocodiles may not exhibit a noticeable shift in cooling canal usage due to salinity.

The FWCC (2008) based their assessment on a salinity range of 40 to 50 ppt. In their Environmental Report for the EPU, FPL (2010b) notes that salinity currently ranges from about 40 to 60 ppt, which is a larger range than what the FWCC considered. Further, FPL's 2009 and 2010 annual American crocodile monitoring reports (Mazzotti et al. 2009, 2010) show that salinity varies spatially and seasonally within the canal system and exceeds 60 ppt during some months. Appendix A to this biological assessment contains figures depicting the seasonal salinity variations reported in the 2009 and 2010 crocodile monitoring reports. The NRC concludes that though salinity is unlikely to alter adult crocodiles' ability to survive and reproduce, it may restrict the area of suitable habitat for the species.

Increased salinity should have little effect on hatchling crocodiles as long as they continue to have access to the freshwater that accumulates at the top of berms within the canal system.

Hatchlings prefer lower salinity (<20 ppt) than juvenile and adult crocodiles because they have a limited ability to excrete salt (Mazzotti 1989). Mazzotti et al. (1986) found that elevated temperatures (>40 °C [104 °F]) or higher salinities (40 ppt) cause hatchlings to reduce their food intake. Thus, hatchlings exposed to higher salinities lose critical body mass. Based on the salinity measurements in the 2009 and 2010 annual American crocodile monitoring reports (Mazzotti et al. 2009, 2010), the salinity of the cooling canal system is already above the 40 ppt tolerance of hatchlings. Under EPU conditions, the salinity would increase by an additional 2 to 3 ppt, which would cause further stress to hatchlings.

Hatchling survival at Turkey Point is largely dependent on the presence of freshwater pools located in depressions on canal berms, which act as refugia from high temperature and salinity waters of the canal system. Freshwater pools would be unaffected by the proposed EPU and would, therefore, continue to provide sufficient habitat to hatchlings. FPL's crocodile management plan includes provision for FPL to continue maintaining the freshwater pools, which will ensure that the pools will continue to provide refugia under EPU conditions (FPL 2010b).

6.4 Proposed Action Effects on American Crocodile Critical Habitat

As discussed in Section 2.3 of this biological assessment, the proposed EPU would increase the temperature and salinity of the cooling canal system water. Section 6.3 discusses the reduction in available habitat that would result from the increased temperatures under EPU conditions. The combination of increased temperatures and increased salinity, especially in the northern portion of the canal system, would likely reduce the value of the cooling canal system as critical habitat for the American crocodile.

7.0 Cumulative Effects Analysis

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). The action area (as described in Section 3.0) includes the Turkey Point site and cooling canal system, Biscayne Bay, and Card Sound.

The FWS and NMFS's Consultation Handbook (1998) notes that the cumulative effects under the ESA do not include Federal activities because those actions would be subject to consultation pursuant to section 7 of the Act. Nonetheless, this discussion of cumulative impacts includes FPL's application to construct two new nuclear units on the Turkey Point site. Though the decision of whether to license the new units is a separate Federal action and NRC will prepare and submit to the FWS a separate biological assessment for this action, a brief description of the potential effects is included in this section for completeness.

Species Recovery Plan and Habitat Enhancements

The protective measures afforded the American crocodile under the ESA have allowed the Florida population to double in size and significantly expand its range since its listing in 1975 (72 FR 13027). FWS reclassified the Florida population as a distinct population segment in 2007 and reduced the listing status to threatened, which reflects the population's steps towards recovery. The FWS (2007) currently manages the recovery of the American crocodile under the *South Florida Multi-Species Recovery Plan*. This plan includes monitoring and management objectives, and species- and habitat-level recovery actions.

State, non-profit, private and other wetland restoration projects in the vicinity of Turkey Point also positively affect the American crocodile by providing additional habitat. The Miami-Dade Department of Environmental Resources Management oversees a number of coastal wetland restoration projects within the County and Biscayne Bay (Milano 1999, 2000). Additionally, FPL (2011) manages the restoration of more than 13,000 ac (530 ha) of wetlands between Everglades National Park and Biscayne National Park as part of the Everglades Mitigation Bank, which provides connectivity between the two national parks and a larger area of habitat with low human activity. Continued restoration and habitat enhancement efforts will increase available habitat for the Florida crocodile population as a whole and will aid in the recovery of the species.

New Nuclear Units at Turkey Point

FPL applied to the NRC for a combined license to construct and operate two new nuclear units at the Turkey Point site on June 30, 2009 (FPL 2009). The NRC staff relied on FPL (2011)'s combined license application environmental report for the discussion of this proposed action.

The new units, Units 6 and 7, would be located immediately south of the currently operating Turkey Point nuclear units. FPL would disturb approximately 330 ac (130 ha) of wetlands to create the Unit 6 and 7 facility footprints and provide laydown areas for materials and equipment. This area is currently composed of hypersaline mudflats, dwarf mangrove and other wetland habitat, open water, man-made remnant canals, and spoil areas. This 330-ac (130-ha) parcel of land is undisturbed and lies within the geographic area designated as American crocodile critical habitat by the FWS at 50 CFR 17.95(c). Though this land is low quality crocodile habitat, construction of Unit 6 and 7 would result in destruction of critical habitat. FPL would mitigate the loss of crocodile habitat by

creating additional freshwater habitat for juvenile crocodiles on cooling canal system berms and by managing vegetation for native plants on and around the berms. Additionally, FPL currently implements the Everglades Mitigation Bank wetland restoration project.

In addition to critical habitat alteration, crocodiles outside of the disturbed area may be affected by construction noise and increased activity on roads and berms, and could temporarily vacate the area as a result. Nesting females could abandon nests, which would render nests unviable because crocodile eggs require the females to assist them in hatching. The northern end of the return canals is the closest area where nesting has been documented that could be affected by Unit 6 and 7 construction. The return canals are about 300 ft (91 m) away from the proposed Unit 6 and 7 footprint.

FPL anticipates that, if approved, Units 6 and 7 would begin operation in 2022 and 2023, respectively. The units would use closed-cycle, mechanical draft cooling towers for both their circulating and service water cooling systems. FPL would obtain makeup water from the Miami-Dade Water and Sewer Department South District Wastewater Treatment Plant, which is located approximately 9 mi (14 km) north of the Turkey Point site. Therefore, the construction and operation of Units 6 and 7 would not directly increase the heat load of water discharged to the cooling canal system beyond what is proposed for the Units 3 and 4 EPU. FPL predicts that about 0.03 to 0.06 ppt of additional salt would be added to the cooling canal system as a result of cooling tower drift. This additional salt load could also affect hatchling crocodile fresh and brackish water refugia. However, its environmental report, FPL (2011) notes that the known refugia locations are south of the modeled cooling tower drift.

Climate Change

The USGCRP (2009) predicts that the average temperatures in the southeastern U.S. will increase by 4.5 to 9 °F (2.5 to 5 °C) by the 2080s. Continued warming will increase water temperatures and evaporation, thus increasing salinity as well. Smaller bodies of water, such as those on the Turkey Point site, will experience more rapid increases in temperature and salinity. As a result, the cooling canal system and other water features that provide habitat to the American crocodile on the Turkey Point site could become too high in temperature and salinity to provide suitable habitat for the species.

8.0 Conclusion and Determination of Effects

American Crocodile

The NRC staff concludes that the proposed EPU **may adversely affect** the American crocodile. The increased temperatures in the cooling canal system under EPU conditions may 1) decrease available habitat for adult crocodiles, 2) decrease the amount of viable nesting habitat, and 3) decrease hatchling survival rates. The increased salinity is not expected to have a noticeable adverse effect as long as adequate freshwater continues to be available to crocodiles in near proximity to the cooling canal system.

The FDEP conditioned FPL's amended Site Certification to require a monitoring program and annual reports on the American crocodile pre- and post-EPU. This monitoring program will reveal whether the EPU negatively affects crocodiles at Turkey Point. The American crocodile has already adapted to the conditions at the Turkey Point site, which include temperatures and salinities above the species' preference. The NRC staff conclude that the American crocodile could also adapt to the environmental conditions

resulting from the proposed EPU. However, at this time, the NRC staff does not have enough information to conclusively determine whether the American crocodile would readily adapt to such changes or whether the EPU would adversely affect the species.

Other Listed Species

The NRC staff concludes that the proposed EPU will have **no effect** on any of the other 30 species listed in Table .2. The majority of these species have not been recorded as occurring on the Turkey Point site, and the EPU would not affect the areas where the species that are known to exist on the site would occur.

American Crocodile Critical Habitat

The NRC staff concludes that the proposed EPU **may result in adverse modification of critical habitat** because the proposed action would increase the temperature and salinity of the cooling canal system water, which could diminish the value of the American crocodile critical habitat on the Turkey Point site. However, at this time, the NRC staff does not have enough information to conclusively determine whether American crocodile critical habitat would be adversely modified by the proposed EPU. As described above, FPL's continued monitoring will determine if the American crocodile readily adapts to the environmental conditions resulting from the proposed EPU. If the species continues to use the cooling canal system without any noticeable shifts in spatial patterns or density, critical habitat would not be adversely affected. If, on the other hand, American crocodiles shift their habitat usage and do not utilize the cooling canal system as much as they had under pre-EPU conditions, the proposed EPU would be considered to adversely modify critical habitat

9.0 References

9.1 Reference List

44 FR 75074. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Listing With Endangered Status for the American Crocodile Throughout Its Range and the Saltwater Crocodile Exclusive of the Papua New Guinea Population." *Federal Register* 44(244):75074-75076. December 18, 1979. Available at <http://ecos.fws.gov/docs/federal_register/fr371.pdf> (accessed 21 July 2011).

50 CFR Part 17. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 17, "Endangered and threatened wildlife and plants."

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

72 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." *Federal Register* 72(53):13027-13041. March 20, 2007. Available at <<http://www.gpo.gov/fdsys/pkg/FR-2007-03-20/pdf/E7-5037.pdf#page=1>> (accessed 21 July 2011).

Cantillo AY, Hale K, Collins E, Pikula L, Caballero R 2000. *Biscayne Bay: Environmental History and Annotated Bibliography*. NOAA Technical Memorandum NOS NCCOS CCMA 145. July 2000. 636 p. Available at <http://www.aoml.noaa.gov/general/lib/biscayne_bay_bibliography.pdf> (accessed 27 July 2011).

Dunson WA. 1970. Some aspects of electrolyte and water balance in three estuarine reptiles, the diamondback terrapin, American and "Salt Water" crocodiles. *Comparative Biochemistry and Physiology* 32:161-174.

Dunson WA. 1980. Osmoregulation of crocodiles in Everglades National Park, U.S. National Park Service Report T-599. 29 p.

Dunson WA. 1982. Salinity relations of crocodiles in Florida Bay. *Copeia* 1982:374-385.

Ellis TM. 1981. Tolerance of sea water by the American crocodile, *Crocodylus acutus*. *Journal of Herpetology* 15(2):187-192.

Endangered Species Act of 1973. 16 U.S.C. 1531, et seq.

Evans DH, Ellis TM. 1977. Sodium balance in the hatchling American crocodile, *Crocodylus acutus*. *Comparative Biochemistry and Physiology*. 58:159-162.

[FDEP] Florida Department of Environmental Protection. 2008. *Electric Power Plant Site Certification Staff Analysis Report for Turkey Point Unit 3 & 4 Nuclear Uprate Project*. September 10, 2008. 30 p. Available at <http://publicfiles.dep.state.fl.us/siting/outgoing/FPL_Turkey_Point/DEP%20Final%20Staff%20Analysis%20Report/FPL%20TP%203%200&%204%20SAR%20Final.pdf> (accessed 18 July 2011).

[FDEP] Florida Department of Environmental Protection. 2009. *Conditions of Certification for Florida Power & Light Company Turkey Point Plant, Units 3 and 4 Nuclear Power Plant, Unit 5 Combined Cycle Plant*. PA03-45D. June 19, 2009. Available at <http://publicfiles.dep.state.fl.us/Siting/Outgoing/Web/Certification/pa03_45_2009_D.pdf> (accessed 26 July 2011).

[FPL] Florida Power & Light Co. 2000. Turkey Point Plant, Units 3 and 4, License Renewal Application, Appendix E – Applicant's Environmental Report – Operating License Renewal Stage. Revision 1. Miami, Florida. ADAMS Nos. ML003749667 and ML003749627.

[FPL] Florida Power & Light Co. 2009. Letter from Nazar MK, Senior Vice President and Chief Nuclear Officer, FPL, to Johnson M, Office of New Reactors Director, NRC. Subject: Application for combined license for Turkey Point Units 6 and 7. June 30, 2009. ADAMS No. ML091830589.

[FPL] Florida Power & Light Co. 2010a. *Turkey Point Units 3 and 4 License Amendment Request for Extended Power Uprate*. Attachment 1: Descriptions and Technical Justifications for the Renewed Operating License, Technical Specifications, and Licensing Basis Changes. 59 p. ADAMS No. ML103560174.

[FPL] Florida Power & Light Co. 2010b. *Turkey Point Units 3 and 4 License Amendment Request for Extended Power Uprate*. Attachment 7: Supplemental Environmental Report. 36 p. ADAMS No. ML103560183.

[FPL] Florida Power & Light Co. 2011. *Turkey Point Units 6 and 7 Combined License Application*. Part 3, Environmental Report. Revision 2. January 6, 2011. ADAMS No. ML103630177.

[FWCC] Florida Fish and Wildlife Conservation Commission. 2008. Letter from Poole MA, Office of Policy and Stakeholder Coordination Director, to Halpin M, FDEP Siting Administrator. Subject: FWCC agency report on Turkey Point Units 3 & 4 uprate project. August 6, 2008. *in* Appendix II-5 in (FDEP 2009).

[FWS] U.S. Fish and Wildlife Service. 2000a. "Critical Habitat for the American Crocodile (*Crocodylus acutus*) as Defined in the Code of Federal Regulations." Available at <http://www.fws.gov/verobeach/images/pdfLibrary/American_Crocodile_critical_habitat.ppd> (accessed 28 July 2011).

[FWS] U.S. Fish and Wildlife Service. 2000b. "Critical Habitat: What Is It?" Revised May 2000. Available at <<http://www.fws.gov/verobeach/images/pdfLibrary/Critical%20Habitat%20Fact%20Sheet.pdf>> (accessed 21 June 2011).

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

[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 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: Modification to Biological Opinion for Turkey Point Units 3 and 4. May 5, 2006. ADAMS No. ML062420111.

[FWS] U.S. Fish and Wildlife Service. 2007. *South Florida Multi-Species Recovery Plan*. June 28, 2007. Vero Beach, FL: FWS. 507 p. Available at <<http://www.fws.gov/verobeach/index.cfm?Method=programs&NavProgramCategoryID=3&programID=107&ProgramCategoryID=3>> (accessed 21 July 2011).

[FWS] U.S. Fish and Wildlife Service. 2010. "Federally Listed & Candidate Species in Miami-Dade County, Florida." Updated June 9, 2010. Available at <<http://www.fws.gov/verobeach/images/pdfLibrary/Miami-Dade%20County3.pdf>> (accessed 2 August 2011).

[FWS] U.S. Fish and Wildlife Service. 2011. "Find Endangered Species: Species By County Report" for Miami-Dade County. Available at <<http://www.fws.gov/endangered/>> (accessed 21 July 2011).

[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*. Washington, DC: FWS and NMFS. 315 p. Available at <<http://www.fws.gov/caribbean/es/PDF/Sec%207%20Handbook.pdf>> (accessed 2 August 2011).

Gaby R, McMahon MP, Mazzotti FJ, Gillies WN, Wilcox JR. 1985. Ecology of a population of *Crocodylus acutus* at a power plant site in Florida. *Journal of Herpetology* 19(2):189-198.

Kushlan JA, Mazzotti FJ. 1989. Historic and present distribution of the American crocodile in Florida. *Journal of Herpetology* 23(1):1-7.

Mazzotti FJ. 1983. The ecology of *Crocodylus acutus* in Florida. PhD dissertation, Pennsylvania State University.

Mazzotti FJ, Bohnsack B, McMahon MP, Wilcox JR. 1986. Field and laboratory observations on the effects of high temperature and salinity on hatchling *Crocodylus acutus*. *Herpetologica* 42(2):191-196.

Mazzotti FJ, Cherkiss MS. 2003. Status and Conservation of the American Crocodile in Florida: Recovering an Endangered Species While Restoring an Endangered Ecosystem. Technical Report prepared for the University of Florida, Ft. Lauderdale Research and Education Center. 41 p. Available at <<http://www.nps.gov/ever/nature/science/upload/MON97-7FinalReportSecure.pdf>> (accessed 28 July 2011).

Mazzotti FJ, Brandt LA, Moler P, Cherkiss MS. 2007. American crocodile (*Crocodylus acutus*) in Florida: recommendations for endangered species recovery and ecosystem restoration. *Journal of Herpetology* 41(1):122-132.

Mazzotti FJ, Cherkiss MS, Beauchamp JS. 2009. Annual Report on the American Crocodile Monitoring Program for the Turkey Point Uprate. Prepared for Florida Power & Light Co. Fort Lauderdale, FL: University of Florida. Available at <http://publicfiles.dep.state.fl.us/Siting/Outgoing/FPL_Turkey_Point/Units_6_7/Completeness/Plant_Associated_Facilities/3rd_Round_Completeness/FPL_Response_3rd_Round_Completeness/Round_3_Response_Attachments/3MDC-D-19/TP%20Uprate%20Crocodile%20Annual%20Report%202009%20Mazzotti.pdf> (accessed 2 August 2011).

Mazzotti FJ, Cherkiss MS, Beauchamp JS. 2010. Annual Report on the American Crocodile Monitoring Program for the Turkey Point Uprate. Prepared for Florida Power & Light Co. Fort Lauderdale, FL: University of Florida.

Milano GR. 1999. Restoration of coastal wetlands in southeastern Florida. *Wetland Journal* 11(2):15-24. Available at <http://www.miamidade.gov/derm/library/water/Coastal_Wetlands_Restoration.pdf> (accessed 29 July 2011).

Milano GR. 2000. Island restoration and enhancement in Biscayne Bay, Florida, in Cannizarro PJ (ed.). Proceedings of the 26th Annual Conference on Ecosystem Restoration and Creation. Hillsborough Community College, Tampa, FL. Available at <http://www.miamidade.gov/derm/library/water/Island_Restoration.pdf> (accessed 29 July 2011).

[NRC] U.S. Nuclear Regulatory Commission) 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Volumes 1 and 2, Washington, D.C. May 1996. ADAMS Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 2001. Letter from Carpenter C, Branch Chief, 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 No. ML012420099.

[NRC] U.S. Nuclear Regulatory Commission. 2002. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Turkey Point Plant, Units 2 and 4*. Final Report. NUREG-1437, Supplement 5, Office of Nuclear Reactor Regulation, Washington, D.C. January 2002. ADAMS Nos. ML020280119, ML020280202, and ML020280226.

[NRC] U.S. Nuclear Regulatory Commission. 2006a. Letter from Gillespie F, Division of License Renewal Director, 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 No. ML060860052.

[NRC] U.S. Nuclear Regulatory Commission. 2006b. Letter from Gillespie F, Division of License Renewal Director, to Souza P, Acting Field Supervisor, South Florida Ecological Services Office, FWS. Subject: Request to Modify Biological Opinion for Turkey Point. June 29, 2006. ML061800100.

[NRC] U.S. Nuclear Regulatory Commission. 2007. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. September 24, 2007. ADAMS No. ML093100542.

[NRC] U.S. Nuclear Regulatory Commission. 2008a. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. January 9, 2008. ADAMS No. ML093100545.

[NRC] U.S. Nuclear Regulatory Commission. 2008b. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. July 29, 2008. ADAMS No. ML093100551.

[NRC] U.S. Nuclear Regulatory Commission. 2008b. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. September 25, 2008. ADAMS No. ML093100554.

[NRC] U.S. Nuclear Regulatory Commission. 2010a. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. January 28, 2010. ADAMS No. ML102000146.

[NRC] U.S. Nuclear Regulatory Commission. 2010b. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. March 9, 2010. ADAMS No. ML102000125.

[NRC] U.S. Nuclear Regulatory Commission. 2010c. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. December 26, 2010. ADAMS No. ML103640052.

[NRC] U.S. Nuclear Regulatory Commission. 2010d. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. December 27, 2010. ADAMS No. ML103640051.

[NRC] U.S. Nuclear Regulatory Commission. 2011a. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. January 12, 2011. ADAMS No. ML110310184.

[NRC] U.S. Nuclear Regulatory Commission. 2011b. E-mail from Headquarters Operations Officer. Subject: Turkey Point incidental take. July 21, 2011. ADAMS No. ML11203A253.

[NRC] U.S. Nuclear Regulatory Commission. 2011. "Types of Power Upgrades." Updated March 12, 2011. Available at <<http://www.nrc.gov/reactors/operating/licensing/power-upgrades/type-power.html>> (accessed 18 July 2011).

Ross JP. 2008. Letter to Shultz C, Vero Beach Field Office, FWS. Subject: Effect on crocodiles of proposed changes in cooling water canals at Florida Light and Power-Turkey Point plant. May 12, 2008. *in* Appendix II-5 of (FDEP 2009).

[USGCRP] U.S. Global Change Research Program. 2009. *Global Climate Change Impacts in the United States*. Cambridge, MA: Cambridge University Press. Available at <<http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/download-the-report>> (accessed 29 July 2011).

9.2 Locating References in ADAMS

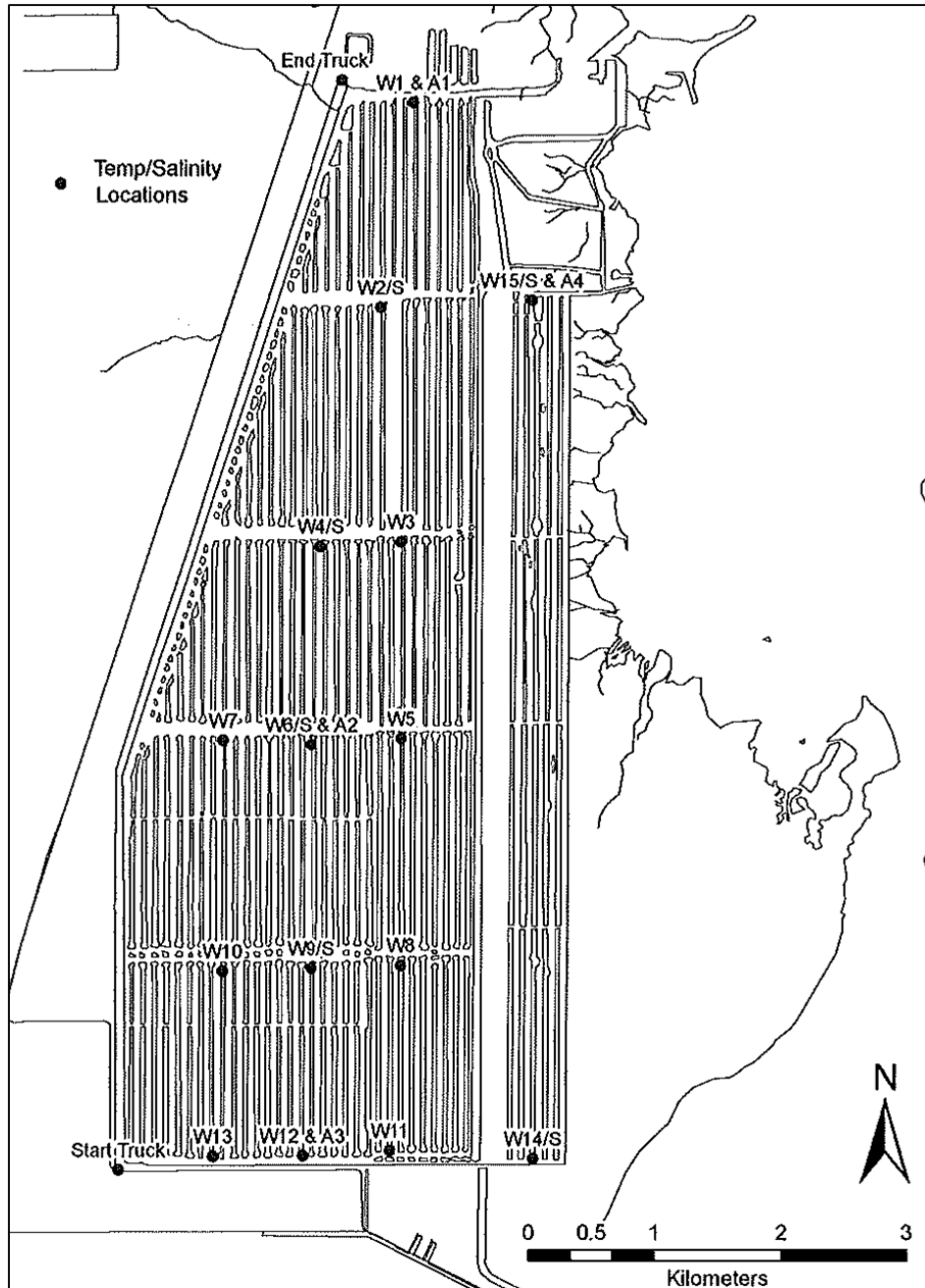
The NRC maintains the Agencywide Document Access and Management System (ADAMS) as its official recordkeeping system. The publicly available version of this system is accessible at <<http://wba.nrc.gov:8080/ves/>>. To locate a reference in

ADAMS, click on the “Simple Search” tab at the top of the page, and enter the ADAMS accession number (listed at the end of those citations that are available in ADAMS) in the search box.

Appendix A

This appendix contains figures depicting the average monthly temperature and salinity in the cooling canal system observed by Mazzotti et al. (2009, 2010) as part of FPL's American Crocodile Monitoring Program for the Turkey Point EPU.

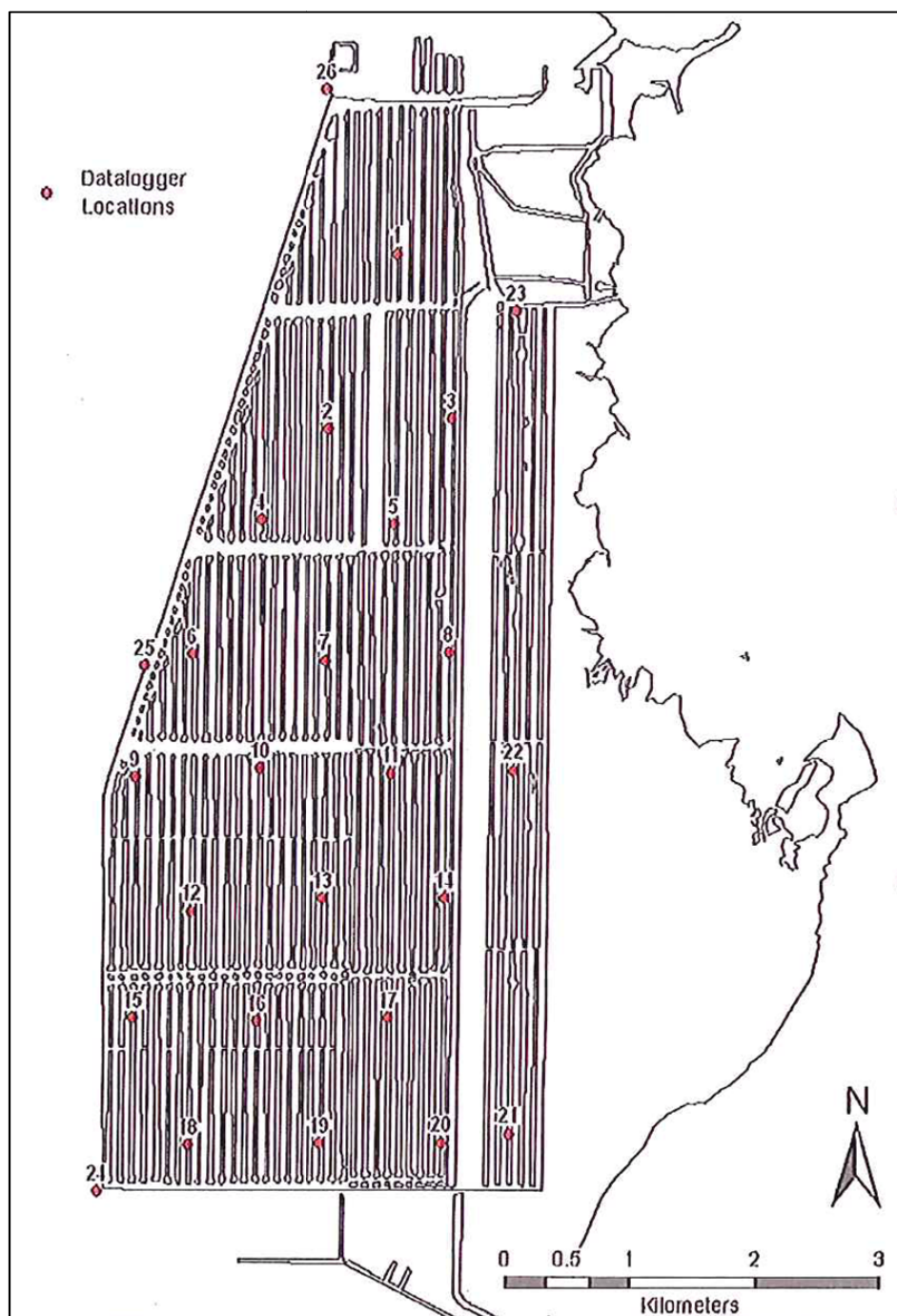
Figure A-1. Water Sample Locations Within the Cooling Canal System, 2009



W1-W15 are water sample locations; A1-A4 are air sample locations. Salinity was recorded at water sample locations designated with an "S."

Image Source: Mazzotti et al. 2009

Figure A-2. Water Sample Locations Within the Cooling Canal System, 2010



Water temperature was recorded at all numbered stations; salinity was recorded at the start and end of each section and at temperature stations 1, 2, 7, 13, and 19.

Image Source: Mazzotti et al. 2010

Figure A-3. Average Cooling Canal Water Temperature, October 2006-September 2009

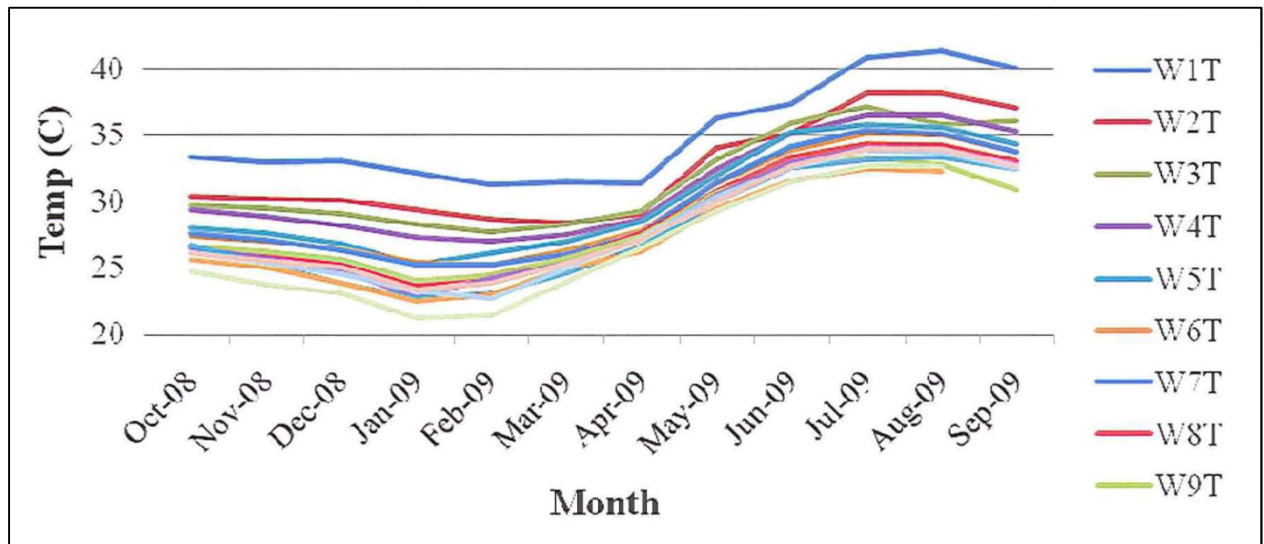


Image Source: Mazzotti et al. 2009

Figure A-4. Average Cooling Canal Water Temperature, February 2010-December 2010

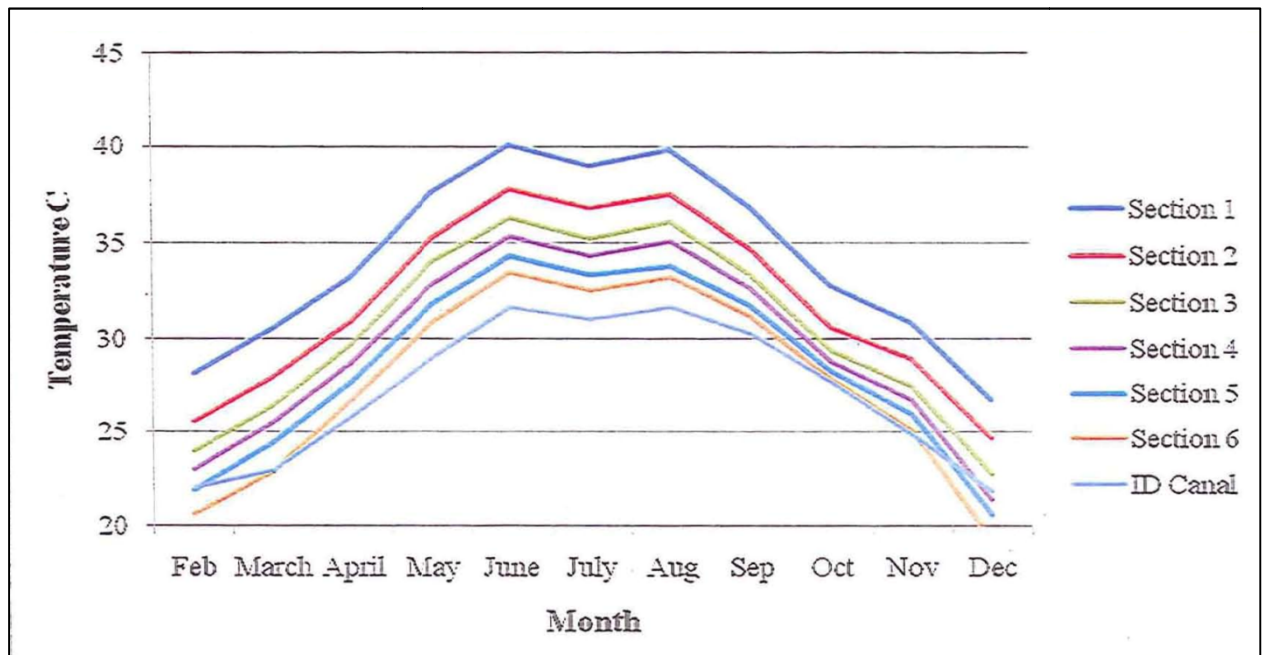


Image Source: Mazzotti et al. 2010

Figure A-5. Average Cooling Canal Water Salinity, February 2010-December 2010

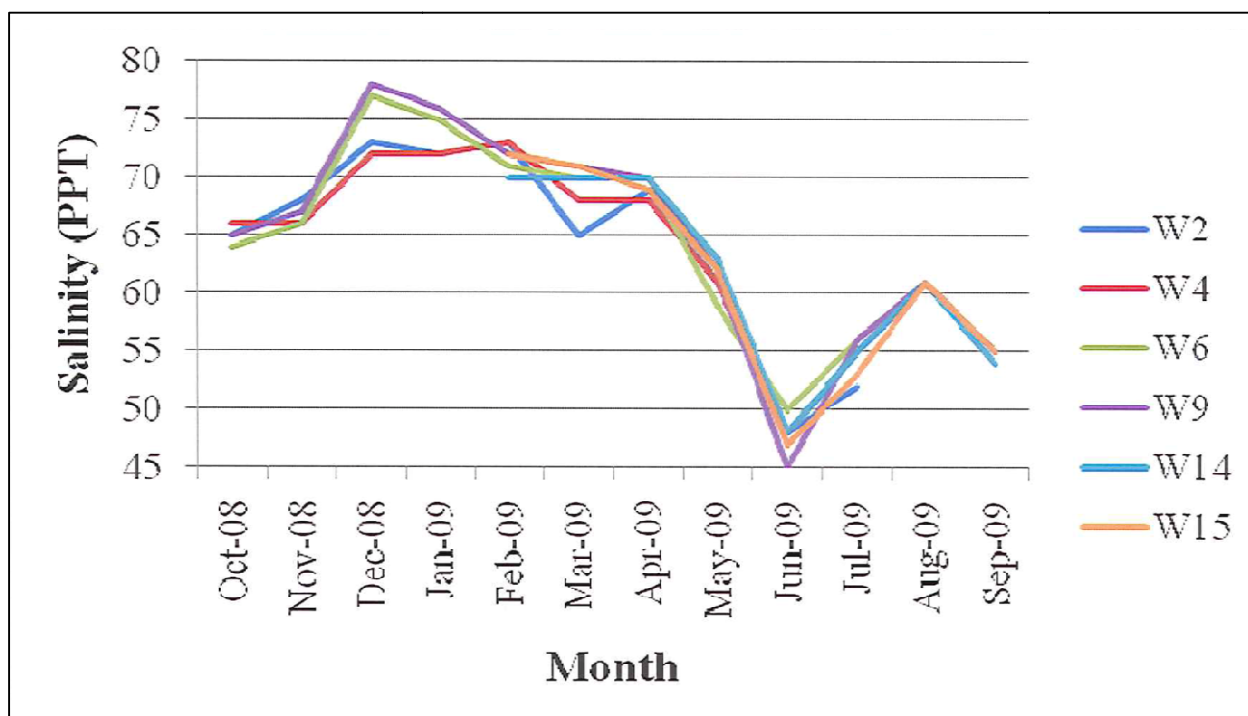


Image Source: Mazzotti et al. 2009

Figure A-6. Average Cooling Canal Water Salinity, February 2010-December 2010

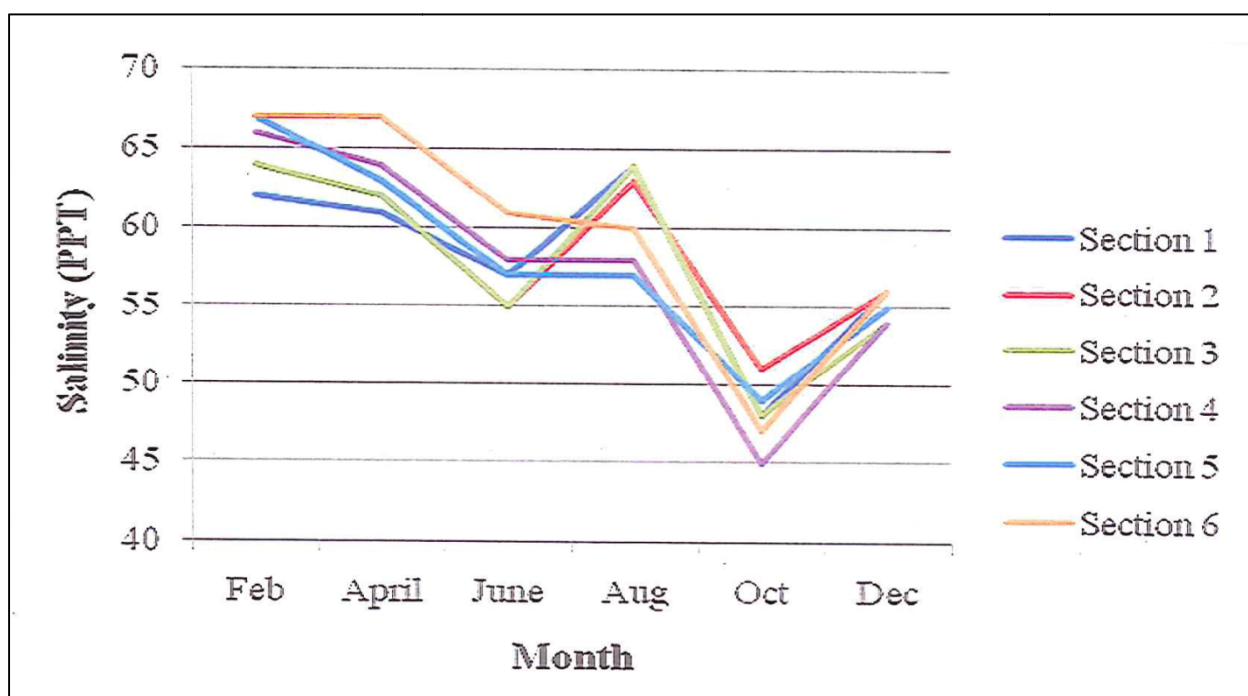


Image Source: Mazzotti et al. 2010