NUREG–1437
Supplement 5,
Second Renewal

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 5, Second Renewal

Regarding Subsequent License Renewal for Turkey Point Nuclear Generating Unit Nos. 3 and 4

Draft Report for Comment

Office of Nuclear Reactor Regulation

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NUREG–1437
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Regarding Subsequent License Renewal for Turkey Point Nuclear Generating Unit Nos. 3 and 4

Draft Report for Comment

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COVER SHEET

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this draft supplemental environmental impact statement (SEIS) as part of its environmental review of Florida Power & Light Company's subsequent license renewal application, to renew the operating licenses for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point or Turkey Point Units 3 and 4) for an additional 20 years. This draft SEIS includes the NRC staff's preliminary evaluation of the environmental impacts of the subsequent license renewal as well as alternatives to subsequent license renewal. Alternatives to subsequent license renewal considered in this draft SEIS include: (1) a new nuclear power plant, (2) a new natural gas combined-cycle power plant, and (3) the combination of a new natural gas combined-cycle power plant and new solar photovoltaic power generation. In addition to replacement power alternatives, this draft SEIS evaluates an alternative cooling water system to mitigate potential impacts associated with the continued use of the existing cooling canal system. The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Turkey Point are not so great that preserving the option of subsequent license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following:

- the analysis and findings in NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by Florida Power & Light Company
- the NRC staff's consultation with Federal, State, Tribal, and local government agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comments

Comments on this draft SEIS should be filed no later than 45 days after the date on which the U.S. Environmental Protection Agency (EPA) notice, stating that this draft SEIS has been filed with the EPA, is published in the *Federal Register*. Comments received after the expiration of the comment period will be considered if it is practical to do so, but assurance of consideration of late comments cannot be given.

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Background

By letter dated January 30, 2018, Florida Power & Light Company (FPL) submitted to the U.S. Nuclear Regulatory Commission (NRC) an application requesting subsequent license renewal for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 renewed facility operating licenses (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML18037A812). FPL subsequently supplemented its application by letters dated February 9, 2018 (ADAMS Accession No. ML18044A653), February 16, 2018 (ADAMS Package Accession No. ML18053A123), March 1, 2018 (ADAMS Package Accession No. ML18072A224), and April 10, 2018 (ADAMS Package Accession No. ML18113A132). The Turkey Point Unit No. 3 current renewed facility operating license (DPR-31) expires at midnight on July 19, 2032; the Turkey Point Unit No. 4 current renewed facility operating license (DPR-41) expires at midnight on April 10, 2033. In its application, FPL requested license renewal for a period of 20 years beyond the dates when the current renewed facility operating licenses expire, to July 19, 2052 for Turkey Point Unit No. 3 and April 10, 2053 for Turkey Point Unit No. 4.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 51.20(b)(2), the renewal of a power reactor operating license requires preparation of an environmental impact statement (EIS) or a supplement to an existing EIS. In addition, 10 CFR 51.95(c), "Operating License Renewal Stage," states that, in connection with the renewal of an operating license, the NRC shall prepare an EIS, which is a supplement to the Commission's NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants."

Once the NRC officially accepted FPL's application, the NRC staff began the environmental review process as described in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The environmental review begins by the NRC publishing a notice of intent in the *Federal Register* to prepare a supplemental environmental impact statement (SEIS) and to conduct environmental scoping. To prepare the Turkey Point SEIS, the NRC staff performed the following:

- conducted two public scoping meetings on May 31, 2018, near the Turkey Point site in Homestead, FL
- conducted a severe accident mitigation alternatives in-office audit in Rockville, MD, from July 5 to July 13, 2018, and an onsite environmental audit at Turkey Point from June 19 to July 22, 2018
- reviewed FPL's environmental report (ER) and compared it to NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the GEIS)
- consulted with Federal, State, Tribal, and local government agencies
- conducted a review of the issues following the guidance set forth in NUREG–1555, Supplement 1, Revision 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal," Final Report
- considered public comments received

Proposed Action

FPL initiated the proposed Federal action (i.e., issuance of renewed facility operating licenses) by submitting an application for subsequent license renewal of Turkey Point. The existing Turkey Point renewed facility operating licenses expire at midnight on July 19, 2032, for Unit No. 3 (DPR-31) and April 10, 2033, for Unit No. 4 (DPR-41). The NRC's Federal action is to decide whether to issue renewed licenses authorizing an additional 20 years of operation. If the NRC issues the renewed licenses, Turkey Point Unit Nos. 3 and 4 would be authorized to operate until July 19, 2052 and April 10, 2053, respectively. The regulation at 10 CFR 2.109, "Effect of Timely Renewal Application," states that if a licensee of a nuclear power plant files an application for renewal of an operating license at least 5 years before the expiration of the existing license, the existing license will not be deemed to have expired until the NRC staff completes its safety and environmental reviews of the application, and the NRC makes a final decision on whether to issue a renewed license for the additional 20 years.

Purpose and Need for Proposed Action

The purpose and need for the proposed action (i.e., issuance of renewed licenses) is to provide an option that allows for power generation capability beyond the term of the current nuclear power plant operating licenses to meet future system generating needs. Energy-planning decisionmakers such as States, utility operators, and, where authorized, Federal agencies (other than the NRC) may determine these future system generating needs. The Atomic Energy Act of 1954, as amended, and the National Environmental Policy Act of 1969, as amended, require the NRC to perform a safety review and an environmental review of the proposed action. The above definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review or in the environmental review that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions as to whether a particular nuclear power plant should continue to operate.

Environmental Impacts of License Renewal

This SEIS evaluates the potential environmental impacts of the proposed action. The NRC designates the environmental impacts from the proposed action as SMALL, MODERATE, or LARGE. NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the GEIS), evaluates 78 environmental issues related to plant operation and classifies each issue as either a Category 1 issue (generic to all or a distinct subset of nuclear power plants) or a Category 2 issue (specific to individual power plants). Category 1 issues are those that meet all the following criteria:

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

- The environmental impacts associated with the issue apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal.
- Mitigation of adverse impacts associated with the issue is considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For Category 1 issues, no additional site-specific analysis is required in this SEIS unless new and significant information is identified. For most issues, the NRC staff did not identify any new and significant information during its review of Florida Power & Light Company's (FPL's) environmental report, the site audits, or the scoping period that would change the conclusions in the GEIS. Therefore, there are no impacts related to these Category 1 issues beyond those already discussed in the GEIS.

Category 2 issues are site-specific issues that do not meet one or more of the criteria for Category 1 issues; therefore, a SEIS must include additional site-specific review for these non-generic issues. In this SEIS, the NRC staff evaluated Category 2 issues applicable to Turkey Point, as well as cumulative impacts and considered new information regarding severe accident mitigation alternatives (SAMAs).

The NRC staff identified and evaluated new and potentially significant information for two existing Category 1 issues (i.e., groundwater quality degradation (plants with cooling ponds in salt marshes) and cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)). In addition, the NRC staff identified and evaluated one new issue not categorized as Category 1 or 2 (i.e., water quality impacts on adjacent water bodies (plants with cooling ponds in salt marshes)). As described in Chapter 4 of this SEIS, the impacts of each of these issues is SMALL. Chapter 4 also presents the process for identifying new and significant information.

Table ES-1 summarizes the Category 2 issues relevant to Turkey Point and the NRC staff's findings related to those issues. If the NRC staff determined that there were no Category 2 issues applicable for a particular resource area, the findings of the GEIS, as documented in Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51, are incorporated for that resource area.

Table ES-1 Summary of NRC Conclusions Relating to Site-Specific Impacts of Subsequent License Renewal at Turkey Point

Resource Area	Relevant Category 2 Issues	Impacts
Groundwater Resources	- Groundwater use conflicts (plants that withdraw more than 100 gallons per minute) - Radionuclides released to groundwater	SMALL to MODERATE SMALL
Terrestrial Resources	- Effects on terrestrial resources (non-cooling system impacts)	SMALL
Aquatic Resources	- Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) - Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL to MODERATE SMALL to MODERATE
Special Status Species and Habitats	- Threatened, endangered, and protected species and essential fish habitat	Likely to adversely affect the American crocodile and eastern indigo snake May affect, but is not likely to adversely affect or no effect to all other species May result in adverse modification to American crocodile critical habitat No adverse modification to West Indian manatee critical habitat No adverse effects on Essential Fish Habitat
Historic and Cultural Resources	- Historic and cultural resources	Would not adversely affect known historic properties or historic and cultural resources
Human Health	- Electric shock hazards	SMALL
Environmental Justice	- Minority and low-income populations	No disproportionately high and adverse human health and environmental effects
Cumulative Impacts	- Cumulative Impacts	See SEIS Section 4.16

Alternatives

As part of its environmental review, the NRC is required to consider alternatives to license renewal and to evaluate the environmental impacts associated with each alternative. These alternatives can include other methods of power generation (replacement power alternatives), as well as not renewing the Turkey Point operating licenses (the no-action alternative).

In total, the NRC staff initially considered 16 replacement power alternatives; the NRC staff later dismissed 13 of these because of technical, resource availability, or commercial limitations that currently exist and that the NRC staff believes are likely to still exist when the current Turkey Point licenses expire.

This left three feasible and commercially viable replacement power alternatives which, in addition to the no-action alternative, the staff evaluates in depth in this report:

- new nuclear power
- natural gas combined-cycle
- combination alternative: natural gas combined-cycle and solar photovoltaic (PV)

These are the 13 additional alternatives that the NRC staff considered but ultimately dismissed:

- solar power
- wind power
- biomass power
- demand-side management
- hydroelectric power
- geothermal power
- wave and ocean energy
- municipal solid waste
- petroleum-fired power
- coal (integrated gasification combined-cycle)
- fuel cells
- purchased power
- delayed retirement of nearby generating facilities

The NRC staff evaluated the environmental impacts of each replacement power alternative, using the same resource areas that it used in evaluating the impacts from subsequent license renewal. In addition, this SEIS evaluates the environmental impacts of an alternative closed-cycle cooling water system, which might be used to mitigate potential impacts associated with the continued use of the existing cooling canal system. Finally, this SEIS evaluates any new and significant information that could alter the conclusions of the SAMA analysis that was performed previously, in connection with the initial license renewal of Turkey Point Unit Nos. 3 and 4.

Preliminary Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Turkey Point are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following:

- the analysis and findings in NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by FPL
- the NRC staff's consultation with Federal, State, Tribal, and local government agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comments

ABBREVIATIONS AND ACRONYMS

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
AADT	average annual daily traffic
ac	acre(s)
ACHP	Advisory Council on Historic Preservation
ACR	Atlantic Coastal Ridge
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954 (as amended)
ALARA	as low as reasonable achievable
APE	Area of Potential Affects
AQCR	Air Quality Control Region
ARB	Homestead Air Reserve Base
ASLB	Atomic Safety and Licensing Board
BLM	Bureau of Land Management
bls	below land surface
BMPs	best management practices
CAA	Clean Air Act
CCS	cooling canal system
CCW	component cooling water
CDMP	Comprehensive Master Development Plan
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Plan
CFR	*Code of Federal Regulations*
cfs	cubic foot (feet) per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2/MWh	carbon dioxide per megawatt hour
CO_{2eq}	carbon dioxide equivalents
COL	combined license
CVCS	chemical and volume control system
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dBA	A-weighted decibels

DERM	Miami-Dade County Division of Environmental Resource Management
DOE	U.S. Department of Energy
DOH	Florida Department of Health
DPS	distinct population segment
EAI	Ecological Associates, Inc.
EB	Encyclopedia Britannica
ECFAS2	East Coast Floridan Aquifer System Model - Phase 2
ECOS	Environmental Conservation Online System
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
FAC	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FE	federally listed as endangered
FEIS	final environmental impact statement
FFWCC	Florida Fish and Wildlife Conservation Commission
FLDOE	Florida Department of Education
FPL	Florida Power & Light
fps	feet per second
FR	*Federal Register*
FRN	*Federal Register* notice
ft	foot (feet)
FT	federally listed as threatened
ft^3	cubic foot (feet)
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s)
GEIS	generic environmental impact statement
GHG	Greenhouse Gases
gpd	gallon(s) per day
gpm	gallon(s) per minute
GT	gigatons
GWP	global warming potential

H_2O	water vapor
ha	hectare(s)
HAP	Hazardous Air Pollutant
HFC	hydrofluorocarbons
HIC	high integrity container
ICW	intake cooling water
IPaC	Information for Planning and Conservation
IPCC	Intergovernmental Panel on Climate Change
ISFSI	independent spent fuel storage installation
IWW	industrial wastewater
kg	kilogram(s)
km	kilometer(s)
kW	kilowatt(s)
kWe	kilowatt(s) electric
L/min	liter(s) per minute
lb	pound(s)
LLRW	Low-level radioactive waste
LLW	low level waste
Lpd	liters per day
LRA	license renewal application
m	meter(s)
m/s	meter(s) per second
m^3/day	cubic meters per day
m^3/s	cubic meter(s) per second
MBTA	Migratory Bird Treaty Act
MDC	Miami-Dade County
MDWSD	Miami-Dade Water and Sewer Department
mgd	million gallons per day
mgy	million gallons per year
mi	mile(s)
min	minute(s)
MMT	million metric tons
mph	mile(s) per hour
MSA	Magnuson–Stevens Fishery Conservation and Management Act
MSL	mean sea level
mSv	millisievert
MT	metric ton(s)
MW	megawatt(s)
MWe	megawatt(s) electric
MWh	megawatt hour(s)

MWt	megawatt(s) thermal
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969, as amended
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGCC	natural gas combined-cycle
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service (of the National Oceanic and Atmospheric Administration)
NO_2	nitrogen dioxide
NOV	notice of violation
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
O_3	ozone
ODCM	offsite dose calculation manual
OSHA	Occupational Safety and Health Administration
Pb	lead
PFC	perfluorocarbons
PM	particulate matter
PM_{10}	particulate matter diameter between 2.5 and 10 micrometers
$PM_{2.5}$	particulate matter diameter of 2.5 micrometers or less
ppb	parts per billion
ppm	parts per million
PPSA	Power Plant Siting Act
ppt	parts per thousand
PRA	probabilistic risk assessment
PSD	Prevention of Significant Deterioration
PSU	Practical Salinity Unit
PV	photovoltaic
PWR	pressurized water reactor
RCS	reactor coolant system
REMP	radiological environmental monitoring program
RICE	reciprocating internal combustion engines
ROI	region of influence
RWS	recovery well system
RWST	refueling water storage tank

SAMA	severe accident mitigation alternative
SAT	federally listed due to similarity of appearance to another listed species
SDWA	Safe Drinking Water Act
SDWWTP	Miami-Dade County South District Waste Water Treatment Plant
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SF_6	sulfur hexafluoride
SFRCCC	Southeast Florida Regional Climate Change Compact
SFWMD	South Florida Water Management District
SIP	State implementation plan
SLRA	subsequent license renewal application
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SSC	structure, system, and component
Sv	sievert
TDS	total dissolved solids
Turkey Point	Turkey Point Nuclear Generating Unit Nos. 3 and 4
U.S.	United States
UF	University of Florida
UFA	Upper Floridan aquifer
UFSAR	updated final safety analysis report
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds
WHT	waste holdup tanks
yd^3	cubic yard(s)
μg	microgram
μm	micrometer

1 INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.). This Act is commonly referred to as NEPA. The regulations at 10 CFR Part 51 require the NRC to prepare an environmental impact statement (EIS) before making a decision on whether to issue an operating license or a renewed operating license for a nuclear power plant.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), specifies that licenses for commercial power reactors can be granted for up to 40 years. The initial 40-year licensing period was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility. NRC regulations permit these licenses to be renewed beyond the initial 40-year term for an additional period of time, limited to 20-year increments per renewal, based on the results of an assessment to determine whether the nuclear facility can continue to operate safely during the proposed period of extended operation. There are no limitations in the AEA or NRC regulations restricting the number of times a license may be renewed.

The decision to seek a renewed license rests entirely with nuclear power facility owners and typically is based on the facility's economic viability and the investment necessary to continue to meet NRC safety and environmental requirements. The NRC makes the decision to grant or deny a renewed license based on whether the applicant has demonstrated reasonable assurance that it can meet the environmental and safety requirements in the agency's regulations during the period of extended operation.

1.1 Proposed Federal Action

Florida Power & Light Company (FPL) initiated the proposed Federal action by submitting an application for subsequent license renewal for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point or Turkey Point Units 3 and 4). The current renewed licenses expire at midnight on July 19, 2032, for Unit No. 3 (DPR-31) and at midnight on April 10, 2033, for Unit No. 4 (DPR-41). The NRC's Federal action is to decide whether to issue renewed licenses for an additional 20 years.

1.2 Purpose and Need for the Proposed Federal Action

The purpose and need for the proposed Federal action (issuance of subsequent renewed licenses for Turkey Point Unit Nos. 3 and 4) is to provide an option that allows for power generation capability beyond the term of the current renewed nuclear power plant operating licenses to meet future system generating needs. Such needs may be determined by energy-planning decisionmakers such as State regulators, utility owners, and Federal agencies other than the NRC. This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the NRC's safety review (required by the Atomic Energy Act) or findings in the NRC's environmental analysis (required by NEPA) that would lead the NRC to reject a subsequent license renewal application, the NRC does not have a role in energy-planning decisions as to whether a particular nuclear power plant should continue to operate.

1.3 Major Environmental Review Milestones

FPL submitted an environmental report (ER) (FPL 2018f) as an appendix to its subsequent license renewal application (SLRA) on January 30, 2018 (FPL 2018a). After reviewing the SLRA and environmental report, as supplemented on February 9 (FPL 2018b), February 16 (FPL 2018c), March 1 (FPL 2018d), and April 10, 2018 (FPL 2018e), the NRC staff accepted the application for a detailed technical review on April 26, 2018 (NRC 2018a). On May 2, 2018, the NRC staff published a *Federal Register* notice of acceptability and opportunity for hearing (Volume 83 of the *Federal Register* (FR), page 19304 (83 FR 19304)). On May 22, 2018, the NRC published another notice in the *Federal Register* (83 FR 23726) informing members of the public of the staff's intent to conduct an environmental scoping process, thereby beginning a 30-day scoping comment period.

The NRC staff held two public scoping meetings on May 31, 2018, near the Turkey Point site in Homestead, FL. In January 2019, the NRC issued its "Supplemental Environmental Impact Statement Scoping Process Summary Report, Turkey Point Nuclear Generating Unit Nos. 3 and 4, Miami-Dade County, Florida," which includes the comments received during the scoping process and the NRC staff's responses to those comments (NRC 2019).

To independently verify information that FPL provided in its environmental report, the NRC staff conducted an onsite audit at Turkey Point in June 2018, and an in-office severe accident mitigation alternatives audit at NRC headquarters in July 2018. In a letter dated July 20, 2018, the staff summarized the onsite audit and listed the attendees (NRC 2018c). In a letter dated August 31, 2018, the staff summarized the in-office severe accident mitigation alternatives audit and listed the attendees (NRC 2018d). During these audits, the NRC staff held meetings with plant personnel, reviewed site-specific documentation, toured the facility, and held a government-to-government meeting hosted by the U.S. National Park Service.

Upon completion of the scoping period and audits, and completion of its review of FPL's environmental report and related documents, the NRC staff compiled its findings in this draft supplemental environmental impact statement (SEIS). The NRC staff will make this draft SEIS available for public comment for 45 days. Based on the information gathered during this public comment period, the NRC staff will amend the draft SEIS findings, as necessary, and will then publish the final SEIS. Figure 1-1 shows the major milestones of the environmental review portion of the NRC's subsequent license renewal application review process.

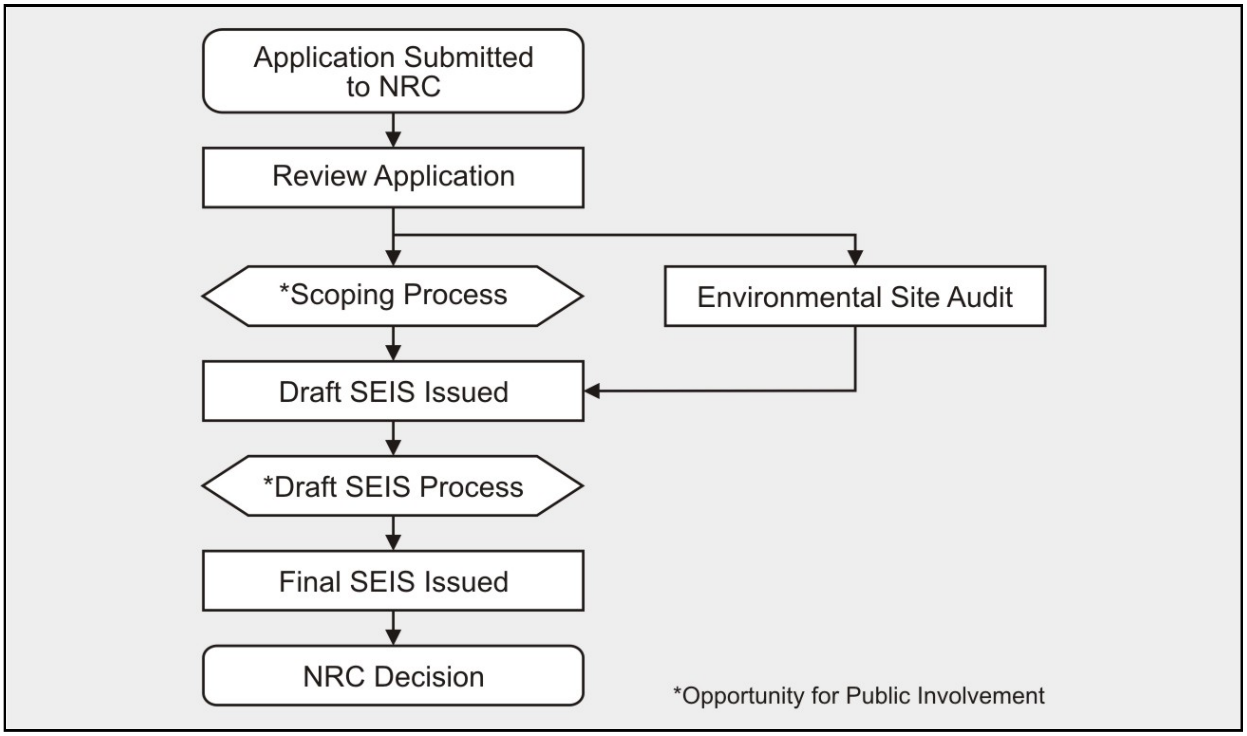


Figure 1-1 Environmental Review Process

The NRC has established a license renewal process that can be completed in a reasonable period of time and that includes clear requirements to assure safe plant operation for up to an additional 20 years of plant life. This process consists of separate environmental and safety reviews, which the NRC staff conducts simultaneously and documents in two reports: (1) the SEIS documents the environmental review and (2) the safety evaluation report (SER) documents the safety review. The staff's findings in the SEIS and the SER are both factors in the NRC's decision to grant or deny the issuance of a renewed license. This process is used for both initial and subsequent license renewal.

1.4 Generic Environmental Impact Statement

To improve the efficiency of its license renewal review process, the NRC staff performed a generic assessment of the environmental impacts associated with license renewal. NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants" (known as the GEIS) (NRC 1996, NRC 1999, NRC 2013a), documents the results of the NRC's systematic approach to evaluating the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. In the GEIS, the staff analyzed in detail and resolved those environmental issues that could be resolved generically. The NRC issued the GEIS in 1996 (NRC 1996), Addendum 1 to the GEIS in 1999 (NRC 1999), and Revision 1 to the GEIS in 2013 (NRC 2013a). Unless otherwise noted, all references to the GEIS include the original 1996 GEIS, Addendum 1, and the 2013 revision. The conclusions in the GEIS apply to both initial and subsequent license renewal.

The GEIS establishes separate environmental impact issues for the NRC staff to independently evaluate. Appendix B to Subpart A of 10 CFR Part 51, "Environmental Effect of Renewing the

Operating License of a Nuclear Power Plant," provides a summary of the staff's findings in the GEIS. For each environmental issue addressed in the GEIS, the NRC staff:

- describes the activity that affects the environment
- identifies the population or resource that is affected
- assesses the nature and magnitude of the impact on the affected population or resource
- characterizes the significance of the effect for both beneficial and adverse effects
- determines whether the results of the analysis apply to all plants
- considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants

The NRC established its standard of significance for impacts using the Council on Environmental Quality terminology for "significant." The NRC established three levels of significance for potential impacts—SMALL, MODERATE, and LARGE—as defined below.

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

> **Significance** indicates the importance of likely environmental impacts and is determined by considering two variables: **context** and **intensity**.
>
> **Context** is the geographic, biophysical, and social context in which the effects will occur.
>
> **Intensity** refers to the severity of the impact in whatever context it occurs.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants (or a distinct subset of plants, as defined in the GEIS) and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 (generic to all or a subset of plants) or Category 2 (site-specific) designation. As established in the GEIS, Category 1 issues are those that meet the following three criteria:

- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants that have a specific type of cooling system or other specified plant or site characteristics.
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For generic issues (Category 1), the SEIS requires no additional site-specific evaluation unless new and significant information has been identified. Chapter 4 of this report describes the process for identifying new and significant information for site-specific analysis. Site-specific issues (Category 2) are those that do not meet the three criteria of Category 1 issues; therefore, the SEIS requires additional site-specific review for these issues.

The 2013 GEIS evaluates 78 environmental issues, provides generically applicable findings for numerous issues (subject to the consideration of any new and significant information on a site-specific basis), and concludes that a site-specific analysis is required for 17 of the 78 issues. Figure 1-2 illustrates the license renewal environmental review process. The results of that site-specific review are documented in the SEIS.

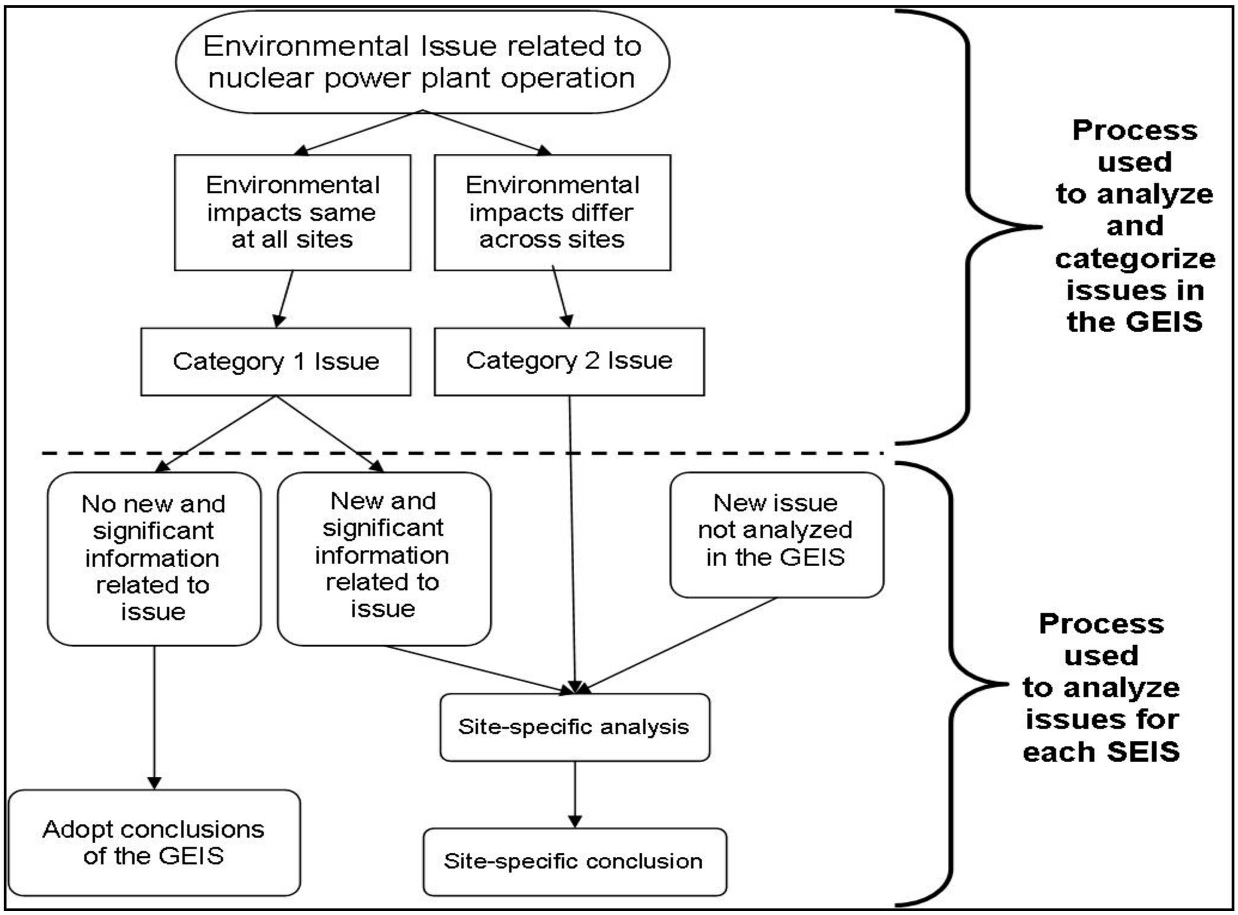


Figure 1-2 Environmental Issues Evaluated for License Renewal

1.5 Supplemental Environmental Impact Statement

This SEIS presents the NRC staff's analysis of the environmental effects of the continued operation of Turkey Point through the subsequent license renewal period, alternatives to subsequent license renewal, and mitigation measures for minimizing adverse environmental impacts. Chapter 4, "Environmental Consequences and Mitigating Actions," contains an analysis and comparison of the potential environmental impacts from subsequent license renewal and alternatives to subsequent license renewal. Chapter 5, "Conclusion," presents the NRC's recommendation on whether the environmental impacts of subsequent license renewal are so great that preserving the option of subsequent license renewal would be unreasonable. The NRC staff will make its final recommendation to the Commission on Turkey Point subsequent license renewal in the final SEIS, which the NRC staff will issue after considering comments received on the draft SEIS during the public comment period.

In the preparation of the Turkey Point draft SEIS, the NRC staff carried out the following activities:

- reviewed the information provided in FPL's environmental report
- consulted with Federal, State, Tribal, and local government agencies
- conducted an independent environmental review, including the environmental and severe accident mitigation analysis site audits
- considered public comments

> **New and significant information**. To merit additional review, information must be both new and significant and it must bear on the proposed action or its impacts.

New information can come from many sources, including the applicant, the NRC, other agencies, or public comments. If the information reveals a new issue, the staff will first analyze the issue to determine whether it is within the scope of the license renewal environmental evaluation. If the staff determines that the new issue bears on the proposed action, the staff will then determine the significance of the issue for the plant and analyze the issue in the SEIS, as appropriate.

1.6 Decisions To Be Supported by the SEIS

This SEIS supports the NRC's decision on whether to issue renewed operating licenses for Turkey Point for an additional 20 years. The regulation at 10 CFR 51.103(a)(5) specifies the NRC's decision standard as follows:

> In making a final decision on a license renewal action pursuant to Part 54 of this chapter [10 CFR], the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

There are many factors that the NRC takes into consideration when deciding whether to renew the operating license of a nuclear power plant. The analyses of environmental impacts in this SEIS will provide the NRC's decisionmaker (in this case, the Commission) with important environmental information for use in the overall decisionmaking process. Other decisions are made outside the regulatory scope of license renewal, by the NRC or other decisionmakers. These include decisions related to: (1) changes to plant cooling systems, (2) disposition of spent nuclear fuel, (3) emergency preparedness, (4) safeguards and security, (5) need for power, and (6) seismicity and flooding (NRC 2013a).

1.7 Cooperating Agencies

The U.S. National Park Service, Southeast Region (NPS), is participating in the environmental review of subsequent license renewal for Turkey Point as a cooperating agency. The NPS does not have any specific regulatory actions related to the proposed subsequent license renewal; however, NPS is providing special expertise for environmental issues pertaining to the areas in and around Biscayne National Park, which is located next to the Turkey Point site. In a letter dated March 5, 2019, the NPS provided comments to the NRC staff on preliminary sections of the draft SEIS discussing water resources, terrestrial resources, aquatic resources, and special status species and habitats (NPS 2019).

1.8 Consultations

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA); the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.) (MSA); and the National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), require Federal agencies to consult with applicable State and Federal agencies and organizations before taking an action that may affect endangered species, fisheries, or historic and archaeological resources, respectively. The NRC staff consulted with the following agencies and organizations during this environmental review:

- U.S. Fish and Wildlife Service
- Miami-Dade County Office of Historic Preservation
- Miccosukee Tribe of Indians of Florida
- Muscogee (Creek) Nation
- Poarch Band of Creek Indians
- The Seminole Nation of Oklahoma
- Seminole Tribe of Florida
- Florida Department of State, Division of Historical Resources
- Federal Advisory Council on Historic Preservation

Appendix C, "Consultation Correspondence," of this SEIS discusses the consultations that the NRC staff conducted in support of this environmental review.

In addition, on June 18, 2018, the NRC staff participated in an interagency meeting related to the proposed subsequent license renewal action. Participating Federal, State, and local agencies included the National Park Service (NPS), U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS), National Oceanic and Atmospheric Administration (NOAA), Florida Department of Environmental Protection (FDEP), and Miami-Dade County Division of Environmental Resources Management (DERM). The primary goals of the meeting included the following:

- Provide an overview of NRC's environmental review process related to FPL's application to renew the operating licenses at Turkey Point.

- Gather input from other Federal, State, and local agencies regarding available environmental data and issues.

During the meeting, the NRC staff provided an overview of the subsequent license renewal process, several agencies presented environmental data and issues related to Turkey Point, and lastly, participants held a general discussion related to the environmental review (NRC 2018l). Information provided by the meeting participants has been considered by the NRC staff in preparing this SEIS.

1.9 Correspondence

During the course of the environmental review, the NRC staff contacted Federal, State, regional, local, and Tribal government agencies listed in Section 1.8 above. Appendix C, "Consultation

Correspondence," chronologically lists all correspondence the NRC staff sent and received during its environmental review, associated with the ESA, the MSA, and the NHPA. Appendix D, "Chronology of Environmental Review Correspondence," chronologically lists all other correspondence.

1.10 Status of Compliance

FPL is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F of the GEIS describes some of the major applicable Federal statutes. Numerous permits and licenses are issued by Federal, State, and local authorities for activities at Turkey Point. Appendix B of this SEIS contains further information about FPL's status of compliance.

1.11 Related State and Federal Activities

The NRC reviewed the possibility that activities of other Federal agencies might affect the renewal of the operating licenses for Turkey Point. There are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this SEIS.

Two Indian reservations, the Miccosukee Indian Reservation (approximately 47 miles (75 km) northwest of Turkey Point) and the Seminole Tribe of Florida, Hollywood Reservation (approximately 43 mi (68 km) north of Turkey Point), are located with 50 miles (80 km) of Turkey Point. The area surrounding the Turkey Point site is low, swampy, and sparsely populated. The Turkey Point site is adjacent to waters and coastal lands that are part of the Biscayne National Park and is within 2 miles (3.2 km) of the Model Lands Basin, a South Florida Water Management District conservation area. A portion of the Biscayne Bay Aquatic Preserve is located immediately east of the Turkey Point site, and a separate portion of the preserve, along with the Florida Keys National Marine Sanctuary, is located adjacent to the south-southeastern border of the Turkey Point site boundary. The Turkey Point site is also located just east of the 13,000-acre Everglades Mitigation Bank. The Homestead Bayfront Park, a city park, is located approximately 2 miles (3.2 km) north-northwest of Turkey Point. (FPL 2018f)

Section 102(2)(C) of NEPA requires the NRC to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the SEIS. In accordance with this requirement, during the course of preparing the SEIS, the NRC consulted, for example, with the U.S. Fish and Wildlife Service. Appendix C provides a complete list of consultation correspondence.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The U.S. Nuclear Regulatory Commission's (NRC's) decisionmaking authority for subsequent license renewal focuses on deciding whether or not to issue a subsequent renewed operating license to a nuclear power plant. The agency's implementation of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.) (NEPA), requires the NRC to consider potential alternatives to issuing a subsequent renewed operating license as well as the environmental impacts of these alternatives. Considering the environmental impacts of subsequent license renewal and comparing those impacts to the environmental impacts of alternatives allows the NRC to determine whether the environmental impacts of subsequent license renewal are so great that it would be unreasonable for the agency to preserve the option of subsequent license renewal for energy-planning decisionmakers (Title 10 of the *Code of Federal Regulations* (10 CFR) 51.95(c)(4)). Ultimately, decisionmakers such as the plant operator, State, or non-NRC Federal officials will decide whether to carry out the proposed action and continue operating the plant for an additional 20 years (if the NRC renews the license) or shut down the plant and choose an alternative power generation source. Economic and environmental considerations play important roles in the decisions of these non-NRC energy-planning decisionmakers.

In general, the NRC's responsibility is to ensure the safe operation of nuclear power facilities, not to formulate energy policy, promote nuclear power, or encourage or discourage the development of alternative power generation sources. The NRC does not engage in energy-planning decisions, and it makes no judgment as to which energy alternatives evaluated in the SEIS would be the best or most-likely alternative to be selected in any given case.

This chapter provides (1) a description of the proposed action (i.e., subsequent renewal of the operating licenses for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4)), (2) an in-depth evaluation of reasonable alternatives to the proposed action (including the no-action alternative), and (3) a brief description of the alternatives to the proposed action that the NRC staff considered but ultimately eliminated from in-depth evaluation.

2.1 Proposed Action

As stated in Section 1.1 of this document, the NRC's proposed Federal action is to decide whether to renew the Turkey Point operating licenses for an additional 20 years. To evaluate the environmental impacts from the continued operation of Turkey Point, the staff will begin with an overview of the facility and the facility's operations, and then consider the affected environment and potential impacts to the affected environment.

Section 2.1.1 below provides a description of normal power plant operations during the subsequent license renewal term. In brief, Turkey Point is a two-unit, nuclear-powered, steam-electric generating facility that began commercial operation in December 1972 (Unit 3) and September 1973 (Unit 4). The nuclear reactors are both Westinghouse pressurized-water reactors (PWRs) and have a combined generating capacity of 1,632 megawatts electric (MWe). Operating at an average capacity factor of 92 percent, the reactors provide approximately 1,500 MWe of net generation (FPL 2018f).

2.1.1 Plant Operations during the Subsequent License Renewal Term

Most plant operation activities during the subsequent license renewal term would be the same as, or similar to, those occurring during the current renewed license term. NUREG–1437, Volume 1, Revision 1, "*Generic Environmental Impact Statement for License Renewal of Nuclear Plants*," (NRC 2013a) (also known as the GEIS) describes the issues that would have the same impact at all nuclear power plants (or a distinct subset of plants, as defined in the GEIS) (i.e., generic issues) as well as those issues that may have different impact levels at different nuclear power plants (i.e., site-specific issues). The impacts of generic issues are described in NUREG–1437 as Category 1 issues; those impacts are set out in NUREG–1437 and Table B-1 of 10 CFR Part 51, Appendix B, and those determinations apply to each license renewal application, subject to the consideration of any new and significant information on a plant-specific basis. A second group of issues (Category 2) was identified in NUREG–1437 as having potentially different impacts at each plant, on a site-specific basis; those issues with plant-specific impact levels need to be discussed in a plant-specific supplemental environmental impact statement (SEIS) to the GEIS, like this one.

Section 2.1.1 of the GEIS, "Plant Operations during the License Renewal Term," describes the general types of activities that are carried out during the operation of all nuclear power plants. These general types of activities include the following:

- reactor operations
- waste management
- security
- office and clerical work
- laboratory analysis
- surveillance, monitoring, and maintenance refueling and other outages

As part of its subsequent license renewal application, Florida Power & Light Company (FPL) submitted an environmental report. FPL's environment report states that Turkey Point will continue to operate during the subsequent license renewal term in the same manner as it would during the current license term with the exception of additional aging management programs to address structure and component aging in accordance with 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

2.1.2 Refurbishment and Other Activities Associated with Subsequent License Renewal

Refurbishment activities include replacement and repair of major structures, systems, and components. The major refurbishment class of activities characterized in the GEIS is intended to encompass actions that typically take place only once in the life of a nuclear plant, if at all (NRC 2013a). For example, replacement of pressurized-water reactor steam generator systems is a refurbishment activity. Refurbishment activities may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the plant-specific design.

In preparation for its license renewal application, FPL evaluated major structures, systems, and components in accordance with 10 CFR 54.21, "Contents of application—technical information," to identify major refurbishment activities necessary for the continued operation of Turkey Point during the proposed 20-year period of extended operation (FPL 2018a).

FPL did not identify any major refurbishment activities necessary for the continued operation of Turkey Point beyond the end of the current renewed operating license term (FPL 2018f).

2.1.3 Termination of Nuclear Power Plant Operations and Decommissioning after the Subsequent License Renewal Term

NUREG–0586, Supplement 1, Volumes 1 and 2, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors" (NRC 2002a) (also known as the decommissioning GEIS), describes the impacts of decommissioning. The majority of plant operations activities would cease with permanent reactor shutdown. However, some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management, office and clerical work, laboratory analysis, surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease operations; however, if these systems are not removed from the site after permanent reactor shutdown, their physical presence may continue to impact the environment. Impacts associated with dedicated systems that remain in place or with shared systems that continue to operate at normal capacities could remain unchanged.

Decommissioning will occur whether Turkey Point is permanently shut down at the end of its current renewed operating license term, or at the end of the subsequent period of extended operation 20 years later. There are no site-specific issues related to decommissioning. The license renewal GEIS concludes that license renewal would have a negligible (SMALL) effect on the impacts of terminating operations and decommissioning on all resources (NRC 2013a).

2.2 Alternatives

As stated above, the National Environmental Policy Act of 1969, as amended (NEPA), requires the NRC to consider reasonable alternatives to the proposed action of issuing subsequent renewed operating licenses for Turkey Point. For a replacement power alternative to be reasonable, it must be both (1) commercially viable on a utility scale and (2) operational before the reactor's operating license expires or expected to become commercially viable on a utility scale and operational before the expiration of the reactor's operating license (NRC 2013a). The 2013 GEIS incorporates the latest information on replacement power alternatives; however, rapidly evolving technologies are likely to outpace the information in the GEIS. As such, for each supplement to the GEIS, the NRC staff must perform a site-specific analysis of replacement power alternatives that accounts for changes in technology and science since the preparation of the most recent GEIS revision.

The first alternative to the proposed action of the NRC issuing subsequent renewed operating licenses for Turkey Point is for the NRC to not issue the licenses. This is called the no-action alternative. Section 2.2.1 below describes the no-action alternative. In addition to the no-action alternative, this chapter discusses three reasonable replacement power alternatives. These alternatives seek to replace Turkey Point's generating capacity by meeting the region's energy needs through other means or sources. Sections 2.2.2.1 through 2.2.2.3 describe replacement power alternatives for Turkey Point. In addition, Section 2.2.3 describes a mechanical draft cooling water system alternative, which the NRC staff evaluated as an alternative to Turkey Point's use of the existing cooling canal system (CCS) to provide cooling water for Turkey Point Units 3 and 4.

2.2.1 No-Action Alternative

Alternatives Evaluated in Depth:

- new nuclear
- natural gas combined-cycle (NGCC)
- combination alternative (NGCC and solar power)

Other Alternatives Considered but Eliminated:

- solar power
- wind power
- biomass
- demand-side management
- hydroelectric power
- geothermal power
- wave and ocean energy
- municipal solid waste
- petroleum-fired power
- coal-fired power
- fuel cells
- purchased power
- delayed retirement of other generating facilities

At some point, all operating nuclear power plants will permanently cease operations and undergo decommissioning. The no-action alternative represents a decision by the NRC to not issue renewed operating licenses to a nuclear power plant beyond the current operating license term. Under the no-action alternative, the NRC does not issue the subsequent renewed operating licenses for Turkey Point, such that the units would shut down at or before the expiration of the current licenses in 2032 (Unit 3) and 2033 (Unit 4). The GEIS describes the environmental impacts that arise directly from permanent plant shutdown. The NRC expects shutdown impacts to be relatively similar whether they occur at the end of the current license term (i.e., after 60 years of operation) or at the end of a subsequent renewed license term (i.e., after 80 years of operation).

After permanent shutdown, plant operators will initiate decommissioning in accordance with 10 CFR 50.82, “Termination of license.” The decommissioning GEIS (NRC 2002a) describes the environmental impacts from decommissioning a nuclear power plant and related activities. The analysis in the decommissioning GEIS bounds the environmental impacts of decommissioning at such time as FPL terminates reactor operations at Turkey Point. Chapter 4 of the license renewal GEIS (NRC 2013a) and Section 4.15.2 of this SEIS describe the incremental environmental impacts of subsequent license renewal on decommissioning activities.

Termination of operations at Turkey Point would result in the total cessation of electrical power production by Turkey Point Units 3 and 4, but not the electrical power produced by the balance of the plant (e.g., Turkey Point Unit 5). Unlike the replacement power alternatives described below in Section 2.2.2, the no-action alternative does not expressly meet the purpose and need of the proposed action, as described in Section 1.2, because the no-action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the power generated by Turkey Point Units 3 and 4, the no-action alternative would likely create a need for a replacement power alternative. The following section describes a wide range of replacement power alternatives, and Chapter 4 assesses their potential environmental impacts. Although the NRC’s authority only extends to deciding whether to renew Turkey Point Units 3 and 4’s current renewed operating licenses, the replacement power alternatives described in the following sections represent possible options for energy-planning decisionmakers if the NRC decides not to issue subsequent renewed operating licenses for Turkey Point Units 3 and 4.

2.2.2 Replacement Power Alternatives

In evaluating alternatives to subsequent license renewal, the NRC considered energy technologies or options currently in commercial operation, as well as technologies not currently in commercial operation but likely to be commercially available by the time the current Turkey Point renewed operating licenses expire on July 19, 2032 (Unit 3) and April 10, 2033 (Unit 4).

The GEIS presents an overview of some alternative energy technologies but does not conclude which alternatives are most appropriate. Because alternative energy technologies are continually evolving in capability and cost and because regulatory structures have changed to either promote or impede the development of particular technologies, the analyses in this chapter rely on a variety of sources of information to determine which alternatives would be available and commercially viable when the current licenses expire. FPL's environmental report provides a discussion of replacement power alternatives. In addition to the information FPL provided in its environmental report, the NRC staff's analyses in this chapter include updated information from the following sources:

- the U.S. Department of Energy's U.S. Energy Information Administration (EIA)
- other offices within the U.S. Department of Energy (DOE)
- the U.S. Environmental Protection Agency (EPA)
- industry sources and publications

In total, the NRC staff considered 16 replacement power alternatives to the proposed action (see text box) and eliminated 13 of these, which left the three reasonable replacement power alternatives for in-depth evaluation described in Sections 2.2.2.1 through 2.2.2.3. The NRC staff's in-depth evaluation of these three alternatives is presented in Chapter 4.

The staff eliminated from in-depth evaluation those alternatives that could not provide the equivalent of Turkey Point Unit 3 and Unit 4's current generating capacity, as they would not be able to satisfy the objective of replacing the power generated by these Turkey Point units. Also, in some cases, the staff eliminated those alternatives whose costs or benefits could not justify inclusion in the range of reasonable alternatives. Further, the staff eliminated as unfeasible those alternatives not likely to be constructed and operational by the time the Turkey Point licenses expire in 2032 (Unit 3) and 2033 (Unit 4). Section 2.3 of this report contains a brief discussion of each eliminated alternative and provides the basis for its elimination. To ensure that the alternatives considered in the SEIS are consistent with State or regional energy policies, the NRC staff reviewed energy-related statutes, regulations, and policies within the Turkey Point region.

The evaluation of each alternative considers the environmental impacts across the following impact categories:

- land use and visual resources
- air quality and noise
- geologic environment
- water resources
- ecological resources
- historic and cultural resources
- socioeconomics, human health, environmental justice
- waste management

The GEIS assigns most site-specific issues (called Category 2 issues) a significance level of SMALL, MODERATE, or LARGE. For ecological resources subject to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA) and the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.) (MSA); and historic and cultural resources subject to the National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), the impact significance determination language is specific to the authorizing legislation. The order in which this SEIS presents the different alternatives does not imply increasing or decreasing level of impact; nor does the order presented imply that an energy-planning decisionmaker would be more (or less) likely to select any given alternative.

Region of Influence

If the NRC does not issue subsequent renewed licenses, procurement of replacement power for Turkey Point Units 3 and 4 may be necessary. Turkey Point is owned and operated by FPL, which provides electricity through its own bulk transmission system to a 35-county service area concentrated in southern Florida and along Florida's Atlantic coast (FPL 2018g). The FPL service territory constitutes the region of influence for the NRC's analysis of Turkey Point replacement power alternatives.

In 2016, electric generators in Florida had a net summer generating capacity of approximately 58,000 megawatts (MW). This capacity included units fueled by natural gas (65 percent), coal (17 percent), petroleum (9 percent), and nuclear power (6 percent). Lesser amounts associated with several other miscellaneous energy sources comprised the balance of generating capacity in the State (EIA 2018a).

The electric industry in Florida provided approximately 238 million megawatt hours (MWh) of electricity in 2016. This electrical production was dominated by natural gas (67 percent), coal (17 percent), and nuclear power (12 percent). Petroleum, biomass, and other miscellaneous energy sources collectively produced the other 4 percent of the electricity in Florida (EIA 2018b).

In the United States, natural gas generation rose from 16 percent of electricity generated in 2000 to 31 percent in 2017. Given known technological and demographic trends, the U.S. Energy Information Administration predicts that by 2050, natural gas will account for 35 percent of electricity generated in the United States (EIA 2013a, EIA 2016a, EIA 2018c). Electricity generated from renewable energy is expected to grow from 13 percent of total generation in 2015 to 30 percent in 2050 (EIA 2016a, EIA 2018d). However, Florida's renewable energy growth may not follow nationwide forecasts. Florida currently obtains only a small portion of its energy from renewable resources, with most of that production primarily generated from biomass, and to a lesser degree from solar and hydroelectric resources (EIA 2017a). The State of Florida does not have a mandatory renewable portfolio standard, and there are other uncertainties that could affect forecasts. In particular, the implementation of policies aimed at reducing greenhouse gas (GHG) emissions could have a direct effect on fossil-fuel-based generation technologies (LBNL 2017a).

The remainder of this section describes in depth the three reasonable replacement power alternatives to Turkey Point subsequent license renewal. These three reasonable alternatives are as follows:

- a new nuclear alternative (Section 2.2.2.1)
- a natural gas combined-cycle alternative (Section 2.2.2.2)
- a combination of natural gas combined-cycle and solar power alternative (Section 2.2.2.3)

Table 2-1 below summarizes key design characteristics of these three alternative replacement power technologies. Section 2.2.3 also describes a possible cooling water system alternative.

Table 2-1 Summary and Key Characteristics of Replacement Power Alternatives Considered In Depth

	New Nuclear Alternative	Natural Gas Combined-Cycle Alternative	Natural Gas Combined-Cycle and Solar Photovoltaic Combination Alternative
Summary of Alternative	Two-unit nuclear plant, each with 750 MWe, for a total of 1,500 MWe	Three 500-MWe units for a total of approximately 1,500 MWe	Approximately 1,420 MWe from natural gas combined-cycle (three units), and 80 MWe from solar PV (four units)
Location	Located within the Turkey Point site, but outside the current footprint of Turkey Point (Units 3 and 4). Also, outside the footprint of Unit 5 (natural gas) and the proposed footprint of Units 6 and 7 (nuclear), which are assumed to be operational. Replacement plant would share existing and planned infrastructure supporting these other units (FPL 2018f).	Located within the Turkey Point site (same location as New Nuclear Alternative). Replacement plant would share existing and planned infrastructure supporting other Turkey Point units. May also require some infrastructure upgrades as well as construction of a new or upgraded pipeline. (FPL 2018f).	Partially located within the Turkey Point site (same location as New Nuclear Alternative for the natural gas combined-cycle plant and one of the four solar PV units; the other three solar PV units would be located at offsite locations within the ROI). Replacement plants would share existing and planned infrastructure supporting other Turkey Point units. May also require some infrastructure upgrades as well as construction of a new or upgraded pipeline. (FPL 2018f).

	New Nuclear Alternative	Natural Gas Combined-Cycle Alternative	Natural Gas Combined-Cycle and Solar Photovoltaic Combination Alternative
Cooling System	Closed cycle with mechanical draft cooling towers. Cooling water withdrawal—38 mgd; consumptive water use—29 mgd (NRC 2016a).	Closed cycle with mechanical draft cooling towers. Cooling water withdrawal—10.5 mgd; consumptive water use—8.1 mgd (NETL 2013).	Natural gas combined-cycle units would use closed-cycle cooling systems with mechanical draft cooling towers. Cooling water withdrawal for these units would be 9.9 mgd; consumptive water use would be 7.7 mgd (NETL 2013). No cooling system would be required for the solar facilities.
Land Requirements	Approximately 360 ac (150 ha). (FPL 2018f).	Approximately 75 ac (30 ha) for the plant, with up to an additional 1,200 ac (490 ha) for right-of-way to connect with existing natural gas supply lines north of the site. No new gas wells would be needed to support the facility (FPL 2018f).	Approximately 540 ac (220 ha) onsite at FPL for the natural gas combined-cycle and solar units, with up to an additional 1,200 ac (490 ha) for right-of-way to connect with existing natural gas supply lines north of the site. No new gas wells would be needed. Three offsite solar units would require approximately 470 ac (190 ha) each, for an offsite total of approximately 1,400 ac (570 ha) (FPL 2018f).
Work Force	3,900 workers during peak construction and 800 workers during operations (NRC 2016a).	1,200 workers during peak construction and 150 workers during operations (NRC 2016a).	Natural gas combined-cycle and solar units would collectively require 1,400 workers during peak construction and 160 workers during operations. (NRC 2016a, DOE 2011).

Key: ac = acres, ha = hectares, mgd = million gallons per day, MWe = megawatts electric, NGCC = natural gas combined-cycle (alternative), PV = photovoltaic, and ROI = region of influence.

2.2.2.1 New Nuclear Alternative

The NRC staff considers the construction of a new nuclear plant to be a reasonable alternative to Turkey Point subsequent license renewal. Nuclear generation currently provides approximately 12 percent of the electricity in Florida (EIA 2018b). One other nuclear power plant operates in the region of influence: the St. Lucie Plant, Units 1 and 2, is located approximately 130 miles (209 km) north of Turkey Point. The NRC staff determined that there may be sufficient time for FPL to prepare and submit an application, build, and operate two new nuclear units using a certified design before the Turkey Point Units 3 and 4 licenses expire in 2032 and 2033.

In evaluating the new nuclear alternative, the NRC staff assumed that FPL would build two new nuclear reactors on a portion of the approximately 9,500-acre (3,800-ha) Turkey Point property. The construction would allow for the maximum use of existing ancillary facilities (e.g., support buildings and transmission infrastructure at location). In addition to Turkey Point Units 3 and 4, the Turkey Point property currently includes Units 1 and 2 (two retired natural gas/oil units), as well as Unit 5 (an operating natural gas combined-cycle unit (FPL 2018f).

In 2018, as part of a separate licensing action, the NRC issued combined licenses (COLs) to FPL for the construction and operation of two new AP1000 nuclear reactor units (Turkey Point Units 6 and 7) at the Turkey Point site (NRC 2018e). These proposed new units would have a combined net electrical output of approximately 2,200 MWe and would be constructed on approximately 220 acres (ac) (89 hectares (ha)) immediately south of Turkey Point Units 3 and 4 (NRC 2018f).

For the purpose of this subsequent license renewal analysis, the NRC staff assumed two separate Westinghouse AP1000 reactors would replace Turkey Point Units 3 and 4. The AP1000 reactors would use the same general design as that described in Chapter 3 of NUREG–2176, “Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7” (NRC 2016a); however, the new nuclear alternative reactors’ location and generating capacity would differ from Turkey Point Units 6 and 7. For the new nuclear alternative, the replacement power facility would be located within the Turkey Point property, but outside the current footprints of Turkey Point Units 3 and 4 and Turkey Point Unit 5, as well as outside the proposed footprint of the not-yet-constructed Turkey Point Units 6 and 7 (FPL 2018f). In addition, the replacement nuclear power facility would be scaled to replace the Turkey Point Units 3 and 4 current net electrical output of approximately 1,500 MWe. This is approximately 32 percent less net electrical output than what the staff evaluated in NUREG–2176 for Turkey Point Units 6 and 7. Accordingly, the heat rejection demands of these new nuclear reactors would also be similar to those of Turkey Point Units 3 and 4. As stated in FPL’s environmental report, the new nuclear alternative would use a mechanical draft cooling tower system. Consistent with the approach and analyses presented in NUREG–2176 (the EIS for the Units 6 and 7 combined licenses), this closed-cycle cooling system would primarily use reclaimed wastewater from the Miami-Dade Water and Sewer Department, with saltwater produced from radial collection wells under Biscayne Bay used as a temporary backup source (FPL 2018f, NRC 2016a). The NRC staff assumes that existing Turkey Point Unit 5 and planned and licensed Turkey Point Units 6 and 7 will continue to be operational during the construction and operation of the new nuclear alternative, and that necessary infrastructure supporting Units 5, 6, and 7 will be available for shared use by the replacement nuclear power facility. Similarly, the NRC staff assumes that the existing transportation and transmission line infrastructure at Turkey Point will be adequate to support the new nuclear alternative, since Units 3 and 4 would not be operating.

The NRC staff also considered the installation of multiple small modular reactors as a new nuclear alternative to renewing the Turkey Point Units 3 and 4 licenses. The NRC established the Advanced Reactor Program in the Office of New Reactors because of considerable interest in small modular reactors along with anticipated license applications from vendors. Small modular reactors generate approximately 300 MW or less, so they have lower initial capacity than that of traditional large-scale units. However, they have greater siting flexibility because they can fit in locations not large enough to accommodate traditional nuclear reactors (DOE 2018b). The NRC received the first design certification application for a small modular reactor in December 2016 (NRC 2017a). Following NRC certification, this design could potentially achieve operation on a commercial scale by 2026 (NuScale 2018). The NRC staff assumes that the resource requirements and key characteristics associated with constructing and operating small modular reactors would be bounded by the larger nuclear units evaluated in this SEIS.

2.2.2.2 Natural Gas Combined-Cycle Alternative

As discussed earlier, natural gas represents approximately 65 percent of the installed generation capacity and 67 percent of the electrical power generated in Florida (EIA 2018a, EIA 2018b). The NRC staff considers the construction of a natural gas combined-cycle power plant to be a reasonable alternative to Turkey Point subsequent license renewal because natural gas is a feasible, commercially available option for providing baseload electrical generating capacity beyond the expiration of Turkey Point's current licenses.

Baseload natural gas combined-cycle power plants (abbreviated in this section as natural gas plants) have proven their reliability and can have capacity factors as high as 87 percent (EIA 2015a). In a natural gas combined-cycle system, electricity is generated using a gas turbine that burns natural gas. A steam turbine uses the heat from gas turbine exhaust through a heat recovery steam generator to produce additional electricity. This two-cycle process has a high rate of efficiency because the natural gas combined-cycle system captures the exhaust heat that otherwise would be lost and reuses it. Similar to other fossil fuel sources, natural gas power plants are a source of greenhouse gases, including carbon dioxide (CO_2). However, a natural gas combined-cycle power plant produces significantly fewer greenhouse gases per unit of electrical output than conventional coal powered plants (NRC 2013a).

For this alternative, the NRC staff assumes that three natural gas units would be constructed and operated to replace Turkey Point's generating capacity. Each natural gas unit would have a gross capacity of approximately 575 MWe and be operated using an 87 percent capacity factor. Together, the three units would collectively replace Turkey Point's approximate net generating capacity of 1500 MWe. Each unit configuration would consist of two combustion turbine generators, two heat recovery steam generators, and one steam turbine generator with mechanical draft cooling towers for heat rejection. The NRC staff assumes that the natural gas power plant will incorporate a selective catalytic reduction system to minimize the plant's nitrogen oxide emissions (NETL 2007). Natural gas would be extracted from the ground through wells, treated to remove impurities, and then blended to meet pipeline gas standards before being piped through the State's pipeline system to the Turkey Point site. The natural gas alternative would produce waste, primarily in the form of spent catalysts used for control of nitrogen oxide emissions.

Similar to the new nuclear alternative (Section 2.2.2.1), the NRC staff assumes that the natural gas replacement power facility would be built on a portion of the approximately 9,500 ac (3,800 ha) Turkey Point property and would allow for the maximum use of the location's existing ancillary facilities (e.g., support buildings and transmission infrastructure). Approximately 75 ac (30 ha) would be used to construct and operate the natural gas plant (FPL 2018f). Depending on the specific site location and proximity of existing natural gas pipelines, the natural gas alternative may also require up to 1,200 ac (490 ha) of land for right-of-way to connect with existing natural gas supply lines north of the site. In its environmental report, FPL states that no new gas wells would be needed to support the natural gas combined-cycle alternative (FPL 2018f).

The NRC staff assumes that the natural gas combined-cycle plant would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this cooling system would withdraw approximately 10.5 million gallons per day (mgd) (39,000 cubic meters per day (m^3/d)) of water and consume 8.1 mgd (31,000 m^3/d) of water (NETL 2013). Because of the high overall thermal efficiency of this type of plant, the natural gas combined-cycle alternative would require less cooling water than Turkey Point subsequent license renewal. Onsite visible structures could include the cooling towers, exhaust stacks, intake and discharge structures, transmission lines, natural gas pipelines, and an electrical switchyard. Construction materials could be delivered by a combination of truck and barge.

2.2.2.3 Combination Alternative (Natural Gas Combined-Cycle and Solar)

This alternative combines natural gas and solar replacement power generation to meet the needs and purpose of the Turkey Point subsequent license renewal. Natural gas and solar power generating facilities currently operate within the region of influence. For the purpose of this evaluation, the NRC staff assumes that (1) a natural gas combined-cycle plant would supply 1,420 MWe, and (2) four separate solar power plants would supply approximately 80 MWe. Further, the staff assumes that the natural gas combined-cycle facility and one of the four solar plants would be located within the Turkey Point property and would use existing available site infrastructure to the extent practicable. The other three solar facilities would be located at offsite locations within the region of influence, specifically within Miami-Dade and Broward counties (FPL 2018f).

<u>Natural Gas Combined-Cycle Portion of Combination Alternative</u>

The natural gas portion of the combination alternative would be generated using a natural gas combined-cycle plant located in the ROI. Although similar in function and appearance to the three-unit natural gas plant described in Section 2.2.2.2, the natural gas plant considered under the combination alternative would have slightly less generating capacity. Specifically, the NRC assumes that the plant would consist of three approximately 545 MWe natural gas units that would be constructed and operated using an 87 percent capacity factor (EIA 2015a) to collectively provide an approximate net generating capacity of 1,420 MWe.

Approximately 70 ac (28 ha) of land would be required to construct and operate the natural gas units (FPL 2018f). Depending on the specific site location and proximity of existing natural gas pipelines, the natural gas portion of this alternative may also require up to 1,200 ac (490 ha) of land for right-of-way to connect with existing natural gas supply lines north of the site. In its environmental report, FPL states that no new gas wells would be needed to support a natural gas combined-cycle power plant (FPL 2018f).

The NRC staff assumes that the natural gas plant would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this system would withdraw approximately 9.9 million gallons-per-day (mgd) (37,000 m^3/d) of water and consume 7.7 mgd (29,000 m^3/d) of water (NETL 2013).

Solar Portion of Combination Alternative

The solar portion of the combination alternative would be generated using solar photovoltaic energy facilities located in the region of influence. For the purpose of this analysis, the NRC assumes that four, approximately 75 MWe, standalone utility-scale solar facilities would be constructed and operated to provide a gross generating capacity of 300 MWe. One of these units would be located on FPL-owned lands in the Turkey Point area, and three units would be located at offsite locations in Miami-Dade County and/or Broward County (FPL 2018f). Assuming a 26-percent capacity factor, the solar units collectively would have an approximate net generating capacity of 80 MWe (FPL 2018f).

Nationwide, growth in utility-scale solar photovoltaic facilities (greater than 1 MW) has resulted in an increase from 70 MW in 2008 to over 20,000 MW installed capacity in 2017 (EIA 2017b). Although Florida has the 3rd-highest solar potential in the Nation, the State only ranks 12th in installed capacity with approximately 725 MW. However, solar energy is projected to supply the most new-renewable-energy capacity to the State over the next decade, and FPL plans to add more than 2,000 MW of additional solar generation capacity during that timeframe (EIA 2017a, FPL 2018f).

Solar photovoltaic resources across Florida range from 5.0 to 5.5 kilowatt hours per square meter per day ($kWh/m^2/day$) (NREL 2017). The feasibility of solar energy resources serving as alternative baseload power is dependent on the location, value, accessibility, and constancy of solar radiation. Solar photovoltaic power generation uses solar panels to convert solar radiation into usable electricity. Solar cells are formed into solar panels that can then be linked into photovoltaic arrays to generate electricity. The electricity generated can be stored, used directly, fed into a large electricity grid, or combined with other electricity generators as a hybrid plant. Solar photovoltaic cells can generate electricity whenever there is sunlight, regardless of whether the sun is directly or indirectly shining on the solar panels. Therefore, solar photovoltaic technologies do not need to directly face and track the sun. This capability has allowed solar photovoltaic systems to have broader geographical use than concentrating solar power (which relies on direct sun) (DOE 2011). Because the region of influence contains above-average solar photovoltaic resources and because solar photovoltaic technology is a commercially available option for providing electrical generating capacity, the NRC staff considers the construction of solar photovoltaic facilities to be a reasonable alternative to subsequent license renewal when combined with natural gas combined-cycle facilities.

Utility-scale solar facilities require large areas of land to be cleared for the solar panels. For standalone sites, solar photovoltaic facilities may require approximately 6.2 ac per megawatt (NRC 2013a). Therefore, approximately 470 ac (190 ha) would be required for each of the four proposed solar power installations needed under this alternative (FPL 2018f). Although not all of this land would be cleared of vegetation and permanently impacted, it represents the land enclosed in the total site boundary of the solar facility (NREL 2013). Solar photovoltaic systems do not require water for cooling purposes but do require a small amount of water to clean the panels and for potable water for the workforce.

2.2.3 Cooling Water System Alternative

In addition to replacement power alternatives, this SEIS evaluates an alternative cooling water system technology for Turkey Point Units 3 and 4 that might be used to mitigate the potential impacts associated with continued use of the existing cooling canal system. The purpose of this analysis is for the NRC staff to compare an alternative closed-cycle cooling system approach with the proposed action to inform the NRC's licensing decision, decisions by other decisionmakers and the public, as applicable, under NEPA. However, the NRC has neither the statutory nor the regulatory authority to determine which system or technology should be used, or to decide other permitting issues, for which the State of Florida has been delegated regulatory authority under the Clean Water Act.

The NRC staff's analysis of the alternative cooling water system draws upon an application which FPL submitted to the NRC in 2009, for COLs to build and operate two new onsite nuclear reactors (Turkey Point Units 6 and 7). The NRC staff conducted an environmental review of that COL application and published it as NUREG–2176. Section 3.2.2.2 of the COL EIS describes a cooling water system alternative to Turkey Point's existing cooling canal system that consists of onsite mechanical draft cooling towers (NRC 2016a). Under the cooling water system alternative that is evaluated by the NRC staff in this license renewal SEIS, Turkey Point Units 3 and 4 would each use three similar closed-cycle wet-cooling towers (six cooling towers in total) to dissipate heat from the reactor cooling water systems. These mechanical draft water towers would be octagonal in shape and extend approximately 70 feet (20 m) in height and 250 feet (75 m) in diameter (NRC 2016a).

The Units 3 and 4 cooling towers would have the same general design, construction, and operating characteristics as the cooling water system associated with the new nuclear alternative described in Section 2.2.2.1 of this SEIS. As in the new nuclear alternative, the primary source of cooling water is assumed to be reclaimed wastewater. Similarly, as summarized in Table 2-1 of this SEIS, cooling water makeup would be approximately 38 mgd (144,000 m^3/d) and consumptive water use would be approximately 29 mgd (110,000 m^3/d). Other discrete resource requirements associated with constructing and operating these cooling towers would be a subset of the overall resource requirements identified in NUREG–2167 (the EIS for the Turkey Point Units 6 and 7 combined licenses) in Tables 3-4 and 3-6 (NRC 2016a).

2.3 Alternatives Considered but Eliminated

The NRC staff originally considered 16 replacement power alternatives to Turkey Point Unit 3 and 4's subsequent license renewal, but ultimately eliminated 13 of these from detailed study. The staff eliminated these 13 alternatives because of technical reasons, resource availability limitations, or commercial or regulatory limitations. Many of these limitations will likely still exist when the current Turkey Point licenses expire in 2032 and 2033, such that these 13 alternatives are not expected to be reasonably available when needed to replace the power generated by Turkey Point Units 3 and 4.

2.3.1 Solar Power

Solar power, including solar photovoltaic (PV) and concentrating solar power (CSP) technologies, produce power generated from sunlight. Solar photovoltaic components convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam. The steam then drives a turbine connected to a generator to ultimately produce electricity (NREL 2014).

Solar generators are considered an intermittent resource because their availability depends on ambient exposure to the sun, also known as solar insolation (EIA 2017c). Insolation rates of solar photovoltaic resources in Florida range from 5.0 to 5.5 kWh/m^2/day (NREL 2017a). Due to higher solar insolation requirements associated with concentrating solar power, utility-scale application of this technology has generally only occurred in western States with high solar thermal resources and large, contiguous tracts of land in arid environments (i.e., California, Arizona, and Nevada) (EIA 2016c). The exception is FPL's Martin generating station, the only concentrating solar power plant east of the Rocky Mountains, which produced approximately 22 percent of the state's utility-scale net solar generation in 2016 (EIA 2017d).

Although Florida has abundant solar resource potential, it generates only a small part of its energy from solar or other renewable resources (EIA 2017a). In addition, Florida does not have a mandatory renewable portfolio standard that would require generators to consider solar power (EIA 2017a). To be considered a viable alternative, a solar alternative must replace the amount of electricity that Turkey Point provides. Assuming capacity factors of 25 to 50 percent (DOE 2011), approximately 3,000 to 6,000 MWe of additional gross solar capacity would need to be installed in the region of influence, which substantially exceeds existing capacity across the state and plans for additional solar generation capacity in the region of influence over the next decade (EIA 2017a, FPL 2018f).

Considering the above factors, the NRC staff concludes that solar power energy facilities alone do not provide a reasonable alternative to Turkey Point subsequent license renewal. However, the NRC staff does consider an alternative using solar power in combination with natural gas combined-cycle power, as described above in Section 2.2.2.3.

2.3.2 Wind Power

As is the case with other renewable energy sources, the feasibility of wind power serving as alternative baseload power is dependent on the location (relative to expected electricity users), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is extracted, and currently there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources.

To be considered a reasonable replacement power alternative to Turkey Point subsequent license renewal, the wind power alternative must replace the amount of electricity that Turkey Point provides. Assuming a capacity factor of 35 percent for land-based wind and 40 percent for offshore wind, a combination of land-based and offshore wind energy facilities in the region of influence would have to generate a range of approximately 3,750 to 4,300 MWe of electricity.

The American Wind Energy Association reports a total of more than 90,000 MW of installed wind energy capacity nationwide as of March 31, 2018 (DOE 2018d). Texas leads all other States in installed land-based wind energy capacity with over 23,000 MW. In contrast, Florida currently has no installed land-based wind power capacity and little overall wind potential to support the development of future wind energy systems (DOE 2018a, EIA 2017a).

Similarly, Florida does not have any utility-scale offshore wind farms in operation. In 2016, a 30 MW project off the coast of Rhode Island become the first operating offshore wind farm in the United States (Energy Daily 2016). Although approximately 20 offshore wind projects representing more than 15,000 MW of capacity were in the planning and permitting process as of 2015, most of these projects are concentrated along the North Atlantic coast, and none are currently planned off the shores of Florida (EIA 2015b, DOE 2018a).

Given the amount of wind capacity necessary to replace Turkey Point, the intermittency of the resource, the current lack of any installed wind capacity in the State, and the limited potential for any new development in the region of influence, the NRC staff finds a wind-based alternative—

either land based, offshore, or some combination of the two—to be an unreasonable alternative to Turkey Point subsequent license renewal.

2.3.3 Biomass Power

Using biomass-fired generation for baseload power depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. For this analysis, the NRC staff assumed that biomass would be combusted for power generation in the electricity sector. Biomass is also used for space heating in residential and commercial buildings and can be converted to a liquid form for use in transportation fuels.

Biomass fuels are abundant in Florida, and currently provide the largest share of Florida's renewable electricity generation (EIA 2017a). In 2016, Florida had a total installed capacity of approximately 1,300 MW, and approximately 2 percent of the State's total system power was produced from biomass (EIA 2018a, EIA 2018b).

For utility-scale biomass electricity generation, the NRC staff assumes that the technologies used for biomass conversion would be similar to fossil fuel plants, including the direct combustion of biomass in a boiler to produce steam (NRC 2013a). Biomass generation is generally more cost effective when co-fired with coal plants (IEA 2007). In 2013, Florida opened the 103-MW Gainesville Renewable Energy Center, one of the largest new biomass plants in the United States (EIA 2016b). Replacing the generating capacity of Turkey Point using only biomass would require the construction of approximately 15 additional facilities of this size. However, most biomass-fired generation plants generally only reach capacities of 50 MW, which means replacing the generating capacity of Turkey Point would require the construction of twice as many new average-sized biomass facilities. Sufficiently increasing biomass-fired generation capacity by expanding existing biomass units or constructing new biomass units by the time Turkey Point's licenses expire in 2032 and 2033, is unlikely. For this reason, the NRC staff does not consider biomass-fired generation to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.4 Demand-Side Management

Energy conservation can include reducing energy demand through behavioral changes or altering the shape of the electricity load, and usually does not require the addition of new generating capacity. Conservation and energy efficiency programs are more broadly referred to as demand-side management.

Conservation and energy efficiency programs can be initiated by a utility, transmission operators, the State, or other load-serving entities. In general, residential electricity consumers have been responsible for the majority of peak load reductions and participation in most programs is voluntary. Therefore, the existence of a program does not guarantee that reductions in electricity demand would occur. The GEIS concludes that, although the energy conservation or energy efficiency potential in the United States is substantial, the NRC staff is aware of no cases where an energy efficiency or conservation program alone has been implemented expressly to replace or offset a large baseload generation station (NRC 2013a).

FPL estimates that demand-side management efforts from 1978 to 2017 have resulted in a total savings of approximately 4,800 MW across its service territory (FPL 2018g). In 2014, the Florida Public Services Commission established FPL's current demand-side management goals, and FPL has accounted for these goals in its planning process through at least 2027.

However, it is unlikely that further cost-effective reductions in electrical demand, particularly in Broward and Miami-Dade counties, could replace Turkey Point's generation (FPL 2018f). Therefore, the NRC staff does not consider demand-side management and energy efficiency programs to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.5 Hydroelectric Power

Currently, approximately 2,000 hydroelectric facilities operate in the United States. Hydroelectric technology captures flowing water and directs it to a turbine and generator to produce electricity (NRC 2013a). There are three variants of hydroelectric power: (1) run-of-the-river (diversion) facilities that redirect the natural flow of a river, stream, or canal through a hydroelectric facility, (2) store-and-release facilities that block the flow of the river by using dams that cause water to accumulate in an upstream reservoir, and (3) pumped storage facilities that use electricity from other power sources to pump water to higher elevations during off-peak load periods to be released during peak load periods through the turbines to generate additional electricity.

A comprehensive survey of hydropower resources, completed in 1997, identified Florida as having only 43 MW of potential hydroelectric capacity when adjusted for environmental, legal, and institutional constraints (Conner et. al., 1998). These constraints could include (1) scenic, cultural, historical, and geological values, (2) Federal and State land use, and (3) legal protection issues, such as wild and scenic legislation and threatened or endangered fish and wildlife legislative protection. A separate DOE assessment of non-powered dams (dams that do not produce electricity) concludes that there is potential for 173 MW of electricity in Florida (ORNL 2012). These non-powered dams serve various purposes, such as providing water supply to inland navigation. However, hydroelectric power accounted for less than one percent of the State's electric power production in 2016 (EIA 2018b). Although the U.S. Energy Information Administration projects that hydropower will remain a leading source of renewable generation in the United States through 2040, there is little expected growth in hydropower capacity (EIA 2013a). The potential for future construction of large hydropower facilities has diminished because of increased public concerns over flooding, habitat alteration and loss, and destruction of natural river courses (NRC 2013a).

Given the projected lack of growth in hydroelectric power production, the low potential capacity in Florida, the competing demands for water resources, and the expected public opposition to the large environmental impacts and significant changes in land use that would result from the construction of hydroelectric facilities, the NRC staff concludes that the expansion of hydroelectric power is not a reasonable alternative to Turkey Point subsequent license renewal.

2.3.6 Geothermal Power

Geothermal technologies extract the heat contained in geologic formations to produce steam to drive a conventional steam turbine generator. Facilities producing electricity from geothermal energy have demonstrated capacity factors of 95 percent or greater, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal power generation to provide baseload power depends on the regional quality and accessibility of geothermal resources. Utility-scale geothermal energy generation requires geothermal reservoirs with a temperature above 200 °F (93 °C). Known geothermal resources are concentrated in the western United States, specifically Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. In general, most assessments of geothermal resources have been concentrated on these western

States (DOE 2013a, USGS 2008a). Geothermal resources are used in the Turkey Point region of influence for heating and cooling purposes, but no electricity is currently being produced from geothermal resources in the region of influence (EIA 2017e). Given the low resource potential in the region of influence, the NRC staff does not consider geothermal to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.7 Wave and Ocean Energy

Waves, currents, and tides are often predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies may be suitable to harness wave energy: (1) terminator devices that range from 500 kilowatts to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM undated). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving a generator to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves then enter a tube and compress air that is used to drive a generator that produces electricity (NRC 2013a). Some of these technologies are undergoing demonstration testing at commercial scales, but none are currently used to provide baseload power (BOEM undated).

Resource assessments show that modest energy production potential is associated with the Florida Current of the Gulf Stream along Florida's southeastern coast (DOE 2018c). However, wave and ocean energy generation technologies are still in their infancy and currently lack commercial application. For these reasons, the NRC staff does not consider wave and ocean energy to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.8 Municipal Solid Waste

Energy recovery from municipal solid waste converts non-recyclable waste materials into usable heat, electricity, or fuel through combustion (EPA 2014a). The three types of combustion technologies include mass burning, modular systems, and refuse-derived fuel systems (EPA 2014b). Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is used to drive a turbine generator to produce electricity. Ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2014b). As of 2016, 77 waste-to-energy plants are in operation in 22 States, processing approximately 30 million tons of waste per year. These waste-to-energy plants have an aggregate capacity of 2,547 MWe. Although some plants have expanded to handle additional waste and to produce more energy, no new plants have been built in the United States since 1995 (EPA 2014a, Michaels 2016). The average waste-to-energy plant produces about 50 MWe, with some reaching 77 MWe, and can operate at capacity factors greater than 90 percent (Michaels 2010). In 2017, municipal solid waste accounted for approximately 450 MW of Florida's electrical capacity (FDACS 2017). Approximately 30 average-sized waste-to-energy plants would be necessary to provide the same level of output as Turkey Point Units 3 and 4.

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than a need for energy. Given the improbability that additional stable supplies of municipal solid waste would be available to support 30 new facilities in the region of influence, the NRC staff does not consider municipal solid waste combustion to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.9 Petroleum-Fired Power

Petroleum-fired electricity generation accounted for approximately 1 percent of Florida's statewide total electricity generation in 2016 (EIA 2018b). The variable costs and environmental impacts of petroleum-fired generation tend to be greater than those of natural gas-fired generation. The historically higher cost of oil has also resulted in a steady decline in its use for electricity generation, and the U.S. Energy Information Administration forecasts no growth in capacity using petroleum-fired power plants through 2040 (EIA 2013a, EIA 2015c). Therefore, the NRC staff does not consider petroleum-fired generation to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.10 Coal-Fired Power

Although coal has historically been the largest source of electricity in the United States, the U.S. Energy Information Administration expects natural gas generation—and potentially even renewable energy generation—to surpass coal generation at the national level by 2040 (EIA 2016a). Florida exemplifies this trend, with coal historically fueling the largest share of electricity generated in the state until 2003, when it was surpassed by natural gas (EIA 2017a). In 2016, coal-fired generation accounted for approximately 17 percent of all electricity generated in Florida, a 21-percent decrease from 2000 levels (EIA 2018b).

Baseload coal units have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the technologies available, pulverized coal boilers producing supercritical steam (supercritical pulverized coal or SCPC boilers) are increasingly common for new coal-fired plants given their generally high thermal efficiencies and overall reliability. Supercritical pulverized coal facilities are more expensive than subcritical coal-fired plants to construct, but they consume less fuel per unit output, reducing environmental impacts. In a supercritical coal-fired power plant, burning coal heats pressurized water. As the supercritical steam and water mixture moves through plant pipes to a turbine generator, the pressure drops and the mixture flashes to steam. The heated steam expands across the turbine stages, which then spin and turn the generator to produce electricity. After passing through the turbine, any remaining steam is condensed back to water in the plant's condenser. Integrated gasification combined cycle is another technology that generates electricity from coal. It combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is cleaner than conventional pulverized coal plants because some of the major pollutants are removed from the gas stream before combustion.

An integrated gasification combined-cycle power plant consists of coal gasification and combined-cycle power generation. Coal gasifiers convert coal into a gas (synthesis gas, also referred to as syngas), which fuels the combined-cycle power generating units. Nearly 100 percent of the nitrogen from the syngas is removed before combustion in the gas turbines and this results in lower nitrogen oxide emissions when compared to conventional coal fired power plants (DOE 2010).

Although several smaller, integrated gasification combined-cycle power plants have been in operation since the mid-1990s, more recent large-scale projects using this technology have experienced a number of setbacks and opposition that have hindered the technology from fully integrating into the energy market. The most significant roadblock has been the high capital cost of an integrated gasification combined-cycle power plant as compared to conventional coal-fired power plants. Both the Duke Energy Edwardsport Generation Station project in Indiana and the Kemper County integrated gasification combined-cycle project in east central

Mississippi have experienced cost and schedule overruns. The Kemper County project suspended work towards startup of the gasifier component in June 2017 (Energy Daily 2017). Other issues associated with integrated gasification combined cycle include a limited track record for reliable performance and opposition based on environmental concerns. In its environmental report, FPL states that it currently has no plans to add new coal-fired generation to its energy production portfolio (FPL 2018f). Based upon these considerations, the NRC staff concludes that coal-fired technologies do not provide a reasonable source of baseload power to replace Turkey Point Units 3 and 4 by the time their current licenses expire in 2032 and 2033.

2.3.11 Fuel Cells

Fuel cells oxidize fuels without combustion and therefore without the environmental side effects of combustion. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts are heat, water, and carbon dioxide (depending on the hydrogen fuel type) (DOE 2013b). Hydrogen fuel can come from a variety of hydrocarbon resources. Natural gas is a typical hydrogen source.

Fuel cells are not economically or technologically competitive with other alternatives for electricity generation. The U.S. Energy Information Administration estimates that fuel cells may cost $7,108 per installed kilowatt (total overnight capital costs in 2012 dollars), which is high compared to other alternative technologies analyzed in this section (EIA 2013b). More importantly, fuel cell units are likely to be small in size (approximately 10 MW). The world’s largest fuel cell facility is a 59 MWe plant that came online in South Korea in 2014 (PEI 2017). Using fuel cells to replace the power that Turkey Point provides would be extremely costly. It would require the construction of approximately 150 average-sized units and modifications to the existing transmission system. Given the immature status and high cost of fuel cell technology, the NRC staff does not consider fuel cells to be a reasonable alternative to Turkey Point subsequent license renewal.

2.3.12 Purchased Power

It is possible that replacement power may be imported from outside the Turkey Point region of influence. Although purchased power would likely have little or no measurable environmental impact in the vicinity of Turkey Point, impacts could occur where the power is generated or anywhere along the transmission route, depending on the generation technologies used to supply the purchased power (NRC 2013a).

As discussed in its report, “2018–2027 Ten Year Power Plant Site Plan,” FPL purchases power from generation sources outside of its service area (FPL 2018g). In 2016 and 2017, FPL purchased 826 MW of firm capacity generation from other such facilities. However, two coal-fired units at the St. John’s River Power Park, in Jacksonville, FL, which provided 382 MW of FPL’s purchased power, retired in January 2018 (FPL 2018f, FPL 2018g). FPL also projects that it will cancel a 330 MW purchase power agreement with a separate coal-fired facility by 2020 because it is no longer cost-effective. Overall, FPL’s firm capacity purchases are expected to average only 250 MW over the next decade (FPL 2018g).

Additionally, purchased power is generally economically adverse because the cost of generated power historically has been less than the cost of the same power provided by a third party (NRC 2013a). Power purchase agreements also carry the inherent risk that the other plant will not deliver the contracted power.

Based on these considerations, the NRC staff concludes that purchased power does not provide a reasonable alternative to Turkey Point subsequent license renewal.

2.3.13 Delayed Retirement

The retirement of a power plant ends its ability to supply electricity. Delaying the retirement of a power plant enables it to continue supplying electricity. A delayed retirement alternative would delay the retirement of generating facilities within or near the region of influence.

Power plant retirement occurs for several reasons. Because generators are required to adhere to additional regulations that will require significant reductions in plant emissions, some power plants may opt for early retirement of older units rather than incur the cost for compliance. Additional retirements may be driven by low natural gas prices, slow growth in electricity demand, and requirements of the Mercury and Air Toxics Standards (EIA 2015c, EPA 2015).

Most units that are near or past retirement age generate more pollutants and are less efficient than new units. Often, utility owners retire units because operation is no longer economical. In some cases, the cost of environmental compliance or necessary repairs or upgrades are too great to justify continued operation.

FPL reviews its existing fleet for cost-effective opportunities to modernize the fleet and extend operations, as well as to evaluate the need to close older inefficient plants. In its “2018–2027 Ten Year Power Plant Site Plan,” FPL identifies the company’s intention to retire two large (approximately 800 MW) generating units at its Martin facility by 2019. These units have been in operation for nearly 40 years and are relatively inefficient. FPL is in the process of modernizing several of its gas-fired generation facilities within its service area, and these ongoing efforts will only partially offset the loss of the Martin units (FPL 2018g). However, FPL has not identified opportunities within its existing fleet that would provide for the replacement of Turkey Point’s net generation (FPL 2018f).

Because of these conditions, the NRC staff concludes that delayed retirement does not provide a reasonable alternative to Turkey Point subsequent license renewal.

2.4 Comparison of Alternatives

In this chapter, the NRC staff considered in depth one alternative to Turkey Point subsequent license renewal that does not replace the plant’s energy generation (the no-action alternative) and three alternatives to subsequent license renewal that may reasonably replace Turkey Point’s energy generation. These three replacement power alternatives are (1) new nuclear generation, (2) natural gas combined-cycle generation, and (3) a combination of natural gas combined-cycle generation and solar photovoltaic generation. The environmental impacts of the proposed action and of the alternatives are described and assessed in Chapter 4. Table 2-2 summarizes the environmental impacts of the three replacement power alternatives to Turkey Point subsequent license renewal.

The environmental impacts of the proposed action (subsequent renewal of the Turkey Point operating licenses) would be SMALL for all impact categories except for groundwater resources and aquatic resources. The impacts to groundwater resources range from SMALL to MODERATE because of groundwater use conflicts and because the site-specific impacts of the Category 1 Issue, Groundwater Quality Degradation (Plants with Cooling Ponds in Salt Marshes), are assessed as MODERATE for current and continued operations during the initial license renewal term but are projected to be SMALL during subsequent license renewal. Due to impingement, entrainment, and thermal impacts on the aquatic organisms in the canal cooling system, the impact of the Turkey Point subsequent license renewal to aquatic resources would be SMALL to MODERATE.

In comparison, each of the three reasonable replacement power alternatives have environmental impacts in at least two resource areas that are greater than the environmental impacts of the proposed action of subsequent license renewal. In addition, the replacement power alternatives also involve the environmental impacts inherent to new construction projects. If the NRC adopts the no-action alternative and does not issue subsequent renewed licenses for Turkey Point, energy-planning decisionmakers would likely implement one of the three power replacement power alternatives discussed in-depth in this chapter. Based on the NRC staff's review of these three replacement power alternatives, the no-action alternative, and the proposed action, the staff concludes that the environmentally preferred alternative is the proposed action of subsequent license renewal. Therefore, the NRC staff proposes to recommend that the NRC issue subsequent renewed operating licenses for Turkey Point Units 3 and 4.

Table 2-2 Summary of Environmental Impacts of the Proposed Action and Alternatives

Impact Area (Resource)	Turkey Point Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative	Natural Gas Combined-Cycle Alternative	Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic)	Cooling Water System Alternative
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL
Visual Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE
Air Quality	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL
Noise	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Geologic Environment	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL
Surface Water Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Groundwater Resources	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL
Terrestrial Resources	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic Resources	SMALL to MODERATE	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE
Special Status Species and Habitats	See Note[a]	See Note[b]	See Note[b]	See Note[b]	See Note[b]	See Note[b]
Historic and Cultural Resources	See Note[c]	See Note[d]	See Note[e]	See Note[e]	See Note[f]	See Note[e]
Socioeconomics	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
Transportation	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Human Health	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]
Environmental Justice	See Note[h]	See Note[i]	See Note[j]	See Note[j]	See Note[k]	See Note[j]
Waste Management and Pollution Prevention	SMALL[l]	SMALL[l]	SMALL [l]	SMALL	SMALL	SMALL

Impact Area (Resource)	Turkey Point Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative	Natural Gas Combined-Cycle Alternative	Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic)	Cooling Water System Alternative

(a) The NRC staff concludes that the proposed Turkey Point subsequent license renewal is likely to adversely affect the American crocodile and the eastern indigo snake and may result in adverse modification to designated critical habitat for the American crocodile. The proposed action may affect, but is not likely to adversely affect, the Florida bonneted bat, Florida panther, West Indian manatee, red knot, piping plover, wood stork, Everglades snail kite, Kirtland's warbler, Blodgett's silverbush, Cape Sable thoroughwort, Florida semaphore cactus, sand flax, Florida bristle fern, loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and smalltooth sawfish. The proposed action would result in no adverse modification to designated critical habitat of the West Indian manatee. The proposed action would have no adverse effects on Essential Fish Habitat. The evaluation of impacts to species and habitats under the U.S. Fish and Wildlife Service's jurisdiction can be found in the NRC's Biological Assessment (NRC 2018n). The evaluation for species and habitats under the National Marine Fisheries Service's jurisdiction can be found in Section 4.8.

(b) The types and magnitudes of adverse impacts to species listed pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), designated critical habitat, and Essential Fish Habitat would depend on Turkey Point shutdown activities, the proposed alternative site, plant design, and operation, as applicable, and on the listed species and designated critical habitats present when the alternative is implemented. Therefore, the NRC staff cannot forecast a particular level of impact for this alternative.

(c) Based on (1) the location of National Register of Historic Places-eligible historic properties within the area of potential effect, (2) tribal input, (3) FPL's cultural resource protection plans, (4) the fact that no license renewal-related physical changes or ground-disturbing activities would occur, (5) Florida State Historic Preservation Office input, and (6) cultural resource assessment, license renewal would not adversely affect any known historic properties (Title 36 of the *Code of Federal Regulations* 800.4(d)(1), "No Historic Properties Affected").

(d) As a result of facility shutdown, land-disturbing activities or dismantlement are not anticipated as these would be conducted during decommissioning. Therefore, facility shutdown would have no immediate effect on historic properties or historic and cultural resources.

(e) Since the alternative would be located at the Turkey Point site, which has a low archeological potential, and avoidance of significant resources would be possible, this alternative would not adversely affect known historic properties.

(f) The impacts from the construction and operation of the solar component would depend on where solar facilities are constructed. The historic and cultural resource impact could range from no adverse effect to adverse effect.

(g) The chronic effects of electromagnetic fields on human health associated with operating nuclear power and other electricity generating plants are uncertain.

(h) There would be no disproportionately high and adverse impacts to minority and low-income populations.

(i) A reduction in tax revenue resulting from the shutdown of Turkey Point could decrease the availability of public services in the Turkey Point area. However, the effects to minority and low-income populations would not be disproportionately high and adverse.

(j) Based on the analysis of human health and environmental impacts presented in this SEIS, the location of the alternative, and the assumed alternative design and characteristics, this alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

(k) This alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations. However, this determination would depend on the location of the solar facilities. Therefore, the NRC staff cannot determine whether the solar portion of the combination alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

(l) NUREG–2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," (NRC 2014c) discusses the environmental impact of spent fuel storage for the timeframe beyond the licensed life for reactor operations.

3 AFFECTED ENVIRONMENT

In conducting its environmental review of the Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4) subsequent license renewal application, the U.S. Nuclear Regulatory Commission (NRC) first defines and describes the environment that could be affected by the subsequent license renewal. For this review, the NRC staff defines the affected environment as the environment that currently exists at and around the Turkey Point site. Because existing conditions are at least partially the result of past construction and operations at the plant, this chapter presents the nature and impacts of these past actions as well as ongoing actions, and evaluates how, together, these actions have shaped the current environment. The effects of ongoing reactor operations at Turkey Point have become well established as environmental conditions have adjusted to the presence of the nuclear power plant. Sections 3.2 through 3.13 describe the affected environment for each resource area. The resource discussions in this chapter include new and updated information that became available since the NRC issued the supplemental environmental impact statement (SEIS) for the initial Turkey Point license renewal in 2002, as NUREG-1437, Supplement 5 (NRC 2002c).

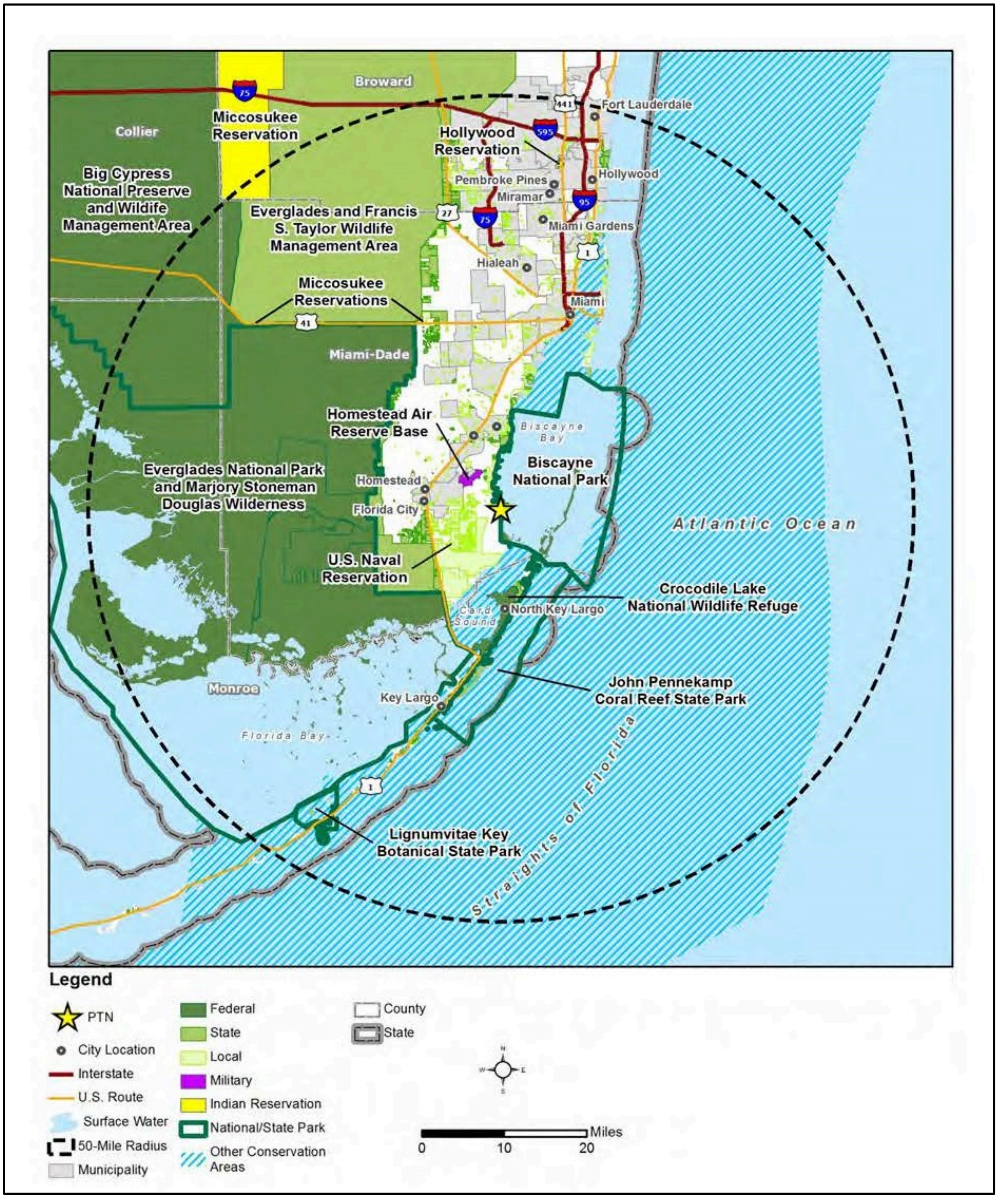
3.1 Description of Nuclear Power Plant Facility and Operation

The physical presence of Turkey Point buildings and facilities, as well as the plant's operations, are integral to the environment that currently exists at and around the site. This section describes Turkey Point buildings, certain nuclear power plant operating systems, and certain plant infrastructure, operations, and maintenance.

3.1.1 External Appearance and Setting

Turkey Point is located on the southeastern coast of Florida in unincorporated southeastern Miami-Dade County. The site borders Biscayne Bay and Card Sound. Turkey Point is approximately 25 miles (mi) (40 kilometers (km)) south-southwest of the city of Miami, which is the largest population center in the region with an estimated population of 424,632. Portions of Homestead Air Reserve Base and the cities of Florida City and Homestead are located within approximately 9 mi (14.5 km) of the Turkey Point site. Miami, Florida City, Homestead, Homestead Air Reserve Base, and Turkey Point are all located in Miami-Dade County, FL. Florida City is located approximately 9 mi (14.5 km) west of Turkey Point and has an estimated population of 12,000. The city of Homestead is located approximately 9 mi (14.5 km) west-northwest of Turkey Point and has an estimated population of 65,000. Homestead Air Reserve Base is located approximately 6 mi (9.7 km) northwest of Turkey Point and has an estimated population of 1,100 (FPL 2018f).

Turkey Point Units 3 and 4 are two pressurized-water nuclear reactors located on approximately 9,460 acres (ac) (38.3 kilometers squared (km^2)) of FPL-owned land. In addition to nuclear generating Units 3 and 4, the Turkey Point site also houses three fossil fuel power plants: Units 1 and 2 are retired, natural-gas/oil steam-generating units; and Unit 5 is an operating, natural-gas combined-cycle steam generating unit. In addition to these five currently operating and retired units, the Turkey Point site also features a 5,900-ac (24 km^2) artificial body of water called the cooling canal system (CCS). This network of canals forms a closed, recirculating source of water that is used by Units 3 and 4 for reactor heat rejection. Unit 5 does not use the cooling canals for heat rejection but does use the CCS for stormwater discharge and cooling water blowdown. The principal structures for Turkey Point Units 3 and 4 are the reactor containments, auxiliary building, control building, turbine building, radioactive waste management building, intake structure, discharge structures, steam generator storage compound, and administration building. The main structures outside the power block are an independent spent fuel storage installation (ISFSI), a sewage treatment plant, a 230-kilovolt (kV) switchyard, a meteorological tower, the cooling water intake canal, the cooling water discharge canal, and the 5,900-ac (24 km^2) network of cooling canals between them (FPL 2018f).



1 **Figure 3-1 Map Showing the 50-mi (80-km) Radius Around the Turkey Point Site**
2 **(FPL 2018f)**

3.1.2 Nuclear Reactor Systems

Turkey Point Units 3 and 4 are Westinghouse, three-loop pressurized-water reactors (PWRs) with dry, ambient pressure containments. The NRC's predecessor agency, the Atomic Energy Commission, issued the Turkey Point Unit 3 facility operating license on July 19, 1972 and the Unit 4 facility operating license on April 10, 1973. Subsequently, on June 6, 2002, the NRC issued renewed facility operating licenses for Turkey Point Units 3 and 4, authorizing an additional 20 years of operation (NRC 2002b). Turkey Point Units 3 and 4 are each rated for a reactor core power level of 2,644 megawatts thermal (MWt) (FPL 2018f). Together, Units 3 and 4 produce a combined total of 1,632 megawatts electric (MWe) (FPL 2018f).

Both the Unit 3 and Unit 4 reactor cores are composed of uranium dioxide pellets enclosed in Zircaloy-4, ZIRLO®, Optimized ZIRLO™ high-performance fuel cladding material tubes with welded end plugs. A spring clip grid structure supports the tubes in assemblies. The mechanical control rods consist of clusters of stainless steel-clad absorber rods and guide tubes located within the fuel assemblies (FPL 2018f).

3.1.3 Cooling and Auxiliary Water Systems

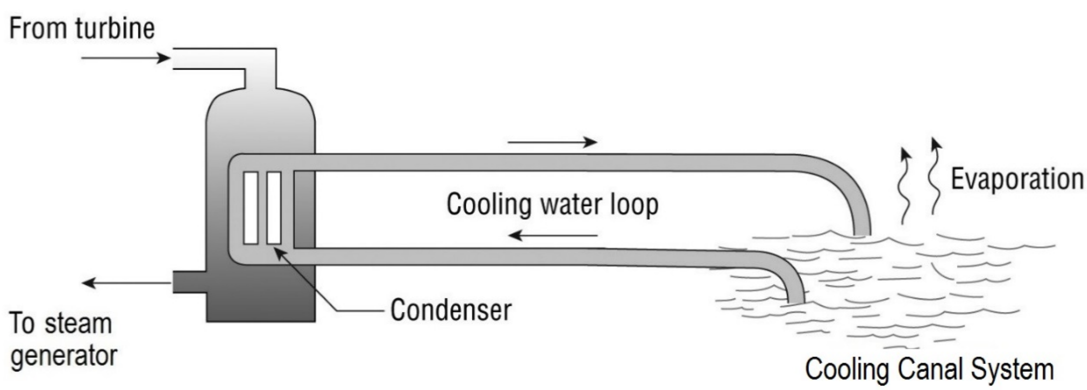
As mentioned earlier, Turkey Point Units 3 and 4 are both PWRs. PWRs heat water under pressure to very high temperatures to create steam. That steam turns the turbines that then generate electricity. PWRs use a closed-cycle cooling system to dissipate the heat in the water. The closed-cycle cooling system uses three heat exchange loops to cool the water: (1) the primary coolant loop, (2) the secondary loop, and (3) the cooling water loop. These are as follows.

Primary Coolant Loop: In the primary coolant loop, water is drawn into the reactor and heated to very high temperatures while under great pressure. The pressure keeps the water from turning into steam. Water in the primary loop that has been heated in the reactor passes through a steam generator where heat is transferred to water in a secondary loop. Once the heat is transferred, the water in the primary coolant loop returns to the reactor to be heated again under high pressure.

Secondary Loop: In the heat transfer process, the water in the primary loop and the water in the secondary loop do not come into contact with each other. In the steam generator, the heated water in the secondary loop is allowed to flash into steam, which is what drives the turbines that in turn produce electricity. The water in the secondary loop (now in steam form), then travels to the condenser where it transfers its heat energy to water in the third loop (called the cooling water loop). When heat is transferred, the water temperature decreases and the steam water in the secondary loop condenses back to liquid water. The liquid water in the secondary loop then returns to the steam generator to be reheated.

Cooling Water Loop: As is the case with the transfer of heat between the primary coolant loop and the secondary loop, in the condenser, the water in the secondary loop and the water in the cooling water loop do not come into contact with one another. From the condenser, water in the cooling water loop (third loop) can either flow to cooling towers (not present for Units 3 and 4) where it is cooled by evaporation or it can be discharged directly to an external body of water (NRC 2013a). Figure 3-2 below shows a simple schematic diagram of a generic PWR cooling system with a cooling canal system. At Turkey Point, water from the cooling water loop is discharged into a closed body of water called the cooling canal system (CCS).

The sections below describe in greater detail the cooling water loop, the CCS, the auxiliary cooling water system, the fire protection water system, and the potable water system at Turkey Point. Unless otherwise cited herein, the NRC staff drew information about Turkey Point's cooling and auxiliary water systems from the following sources: FPL's environmental report that it submitted as part of the subsequent license renewal application (FPL 2018f), the NRC staff's 2002 SEIS for the initial Turkey Point license renewal published as NUREG–1437, Supplement 5 (NRC 2002c), and the NRC staff's onsite environmental audit at Turkey Point in June 2018.



Source: Modified from NRC 2013a

Figure 3-2 Generic Cooling System with Cooling Canal System

3.1.3.1 General Description of Cooling Water Loop

In a PWR closed-cycle cooling system, the primary function of the third loop—the cooling water loop—is to transport heat from inside the reactor to the outside environment. At Turkey Point, the cooling water loop withdraws water from an artificially constructed body of water called the cooling canal system (CCS) and discharges water back to the CCS. As described earlier in this chapter, the CCS is a large body of water comprised of a network of canals spread over about 5,900 ac (24 km^2). As with the rest of the Turkey Point site, FPL does not allow the public to access the CCS. The CCS does not connect to any other surface water bodies. It is an industrial wastewater (IWW) facility under the Clean Water Act and is not considered "waters of the United States" or "waters of the State" (Figure 3-3).

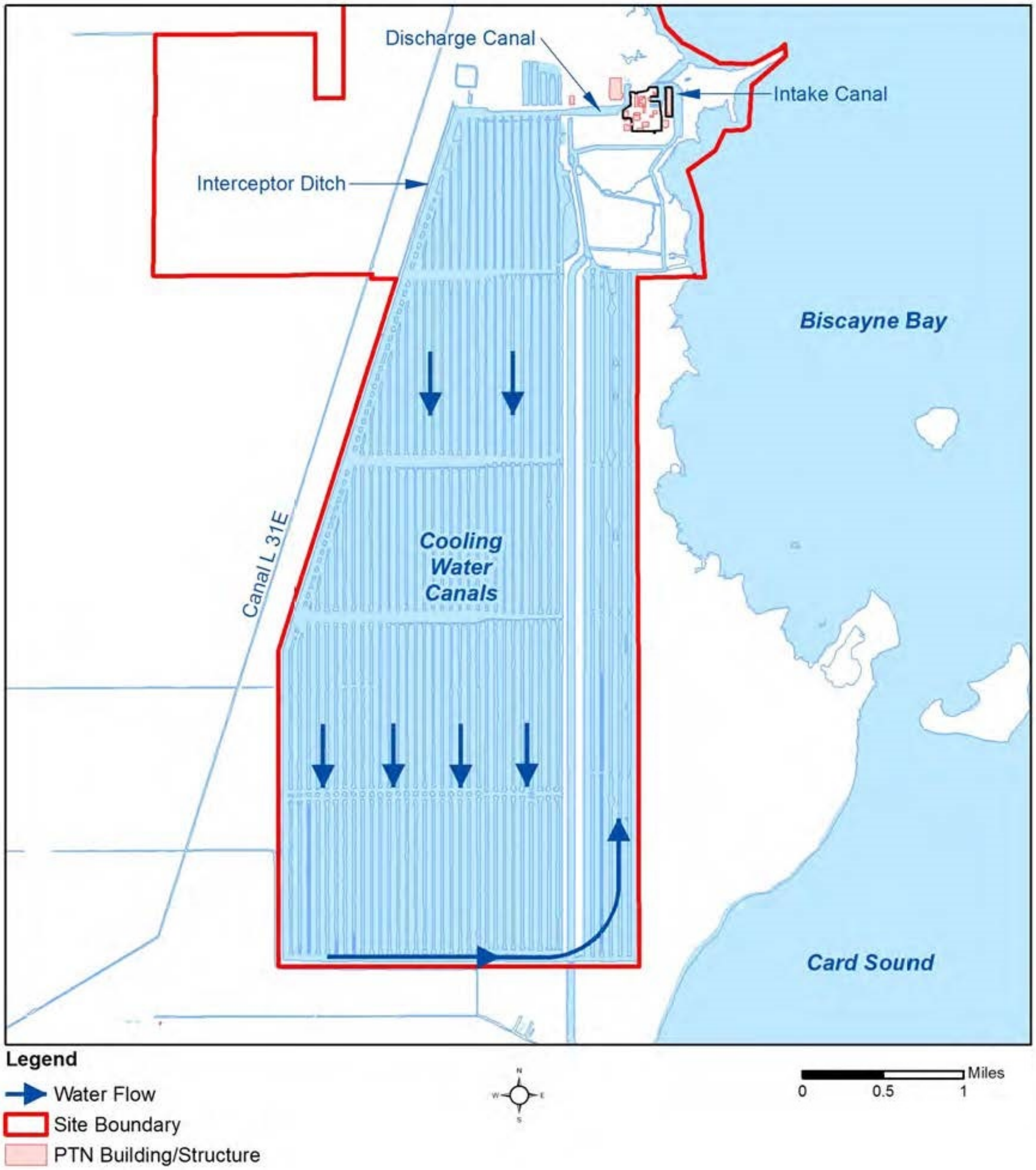
The reactors discharge heated water from the cooling water loop into the discharge canal of the CCS. From the discharge canal, the heated water travels through the length of the canal and loses heat through evaporation. By the time the water returns to the Units 3 and 4 cooling water intake canal, it is lower in temperature than when it was discharged. From the cooling water intake canal, some water is pumped back into the cooling water loop where it is used to dissipate heat from the secondary loop so that the steam water in the secondary loop condenses back into liquid water.

Figure 3-3 illustrates the location where the Units 3 and 4 discharge structure releases heated water into the CCS, the direction of water flow through the CCS, and the location where the

Units 3 and 4 intake structure draws cooling water from the CCS. Section 3.1.3.2, “Cooling Canal System (CCS),” discusses the CCS and its operation in greater detail.

At the Units 3 and 4 cooling water intake structure, water from the CCS flows through bars that prevent large objects from entering the intake structure. Then, the water flows through steel trash racks and into four separated screen wells. The trash racks protect vertical traveling screens against damage from heavy debris. The traveling screens have a 0.38-in (1-cm) mesh size to remove smaller debris. The water then flows to one of four circulating water pumps. The intake structure also contains three pumps that supply water to the condenser. Under normal plant operating conditions, either one, two, or all three of these pumps may be in operation. Inside the cooling water tubes of the condenser, plastic foam balls minimize biological growth and other fouling.

The combined intake of water at the Turkey Point intake structure is 1,872 million gallons per day (mgd) (7 million m^3/day). This water is discharged back to the CCS where it is recirculated for reuse again as cooling water.



Source: FPL 2018f

Figure 3-3 Flow of Water Through the Cooling Canal System

FPL originally built the CCS to service its fossil-fueled units and nuclear generating units. The CCS currently services two nuclear generating units (Units 3 and 4), two retired fossil-fueled units (Units 1 and 2), and one currently operating fossil-fueled unit (Unit 5) in varying capacities. The NRC does not license the operation of the fossil-fueled units.

Historically, the CCS was also part of the cooling water system for Units 1 and 2. The CCS functioned for them as it does for Units 3 and 4. As mentioned earlier, FPL retired Units 1 and 2, so these units no longer generate electricity. However, these retired units still circulate water from the CCS (i.e., discharge water into and withdraw water from the CCS). FPL has placed both units into synchronous condenser mode, which means they support transmission reliability and help to stabilize and optimize electrical grid performance. FPL plans to continue operating Units 1 and 2 in this mode through the period of subsequent license renewal. While in synchronous condenser mode, Units 1 and 2 circulate 17.3 mgd (65,488 m^3/day) of water from the CCS. As Units 1 and 2 no longer produce steam, unlike Units 3 and 4, they no longer discharge heated water to the CCS.

Unit 5 is a currently operating fossil fuel power plant that produces electricity through natural-gas combined-cycle steam generation. It uses four natural gas turbines and one heat-recovery steam-powered generator. It does not use the CCS as part of its cooling water system. Instead, Unit 5 uses cooling towers and obtains water for cooling from groundwater from the Upper Floridan aquifer (see Section 3.5, "Groundwater Resources"). Heat generated by Unit 5 is lost to the atmosphere by the evaporation of water in the plant's cooling towers.

While Unit 5 does not use the CCS for cooling, it does discharge blowdown water from its cooling towers into the CCS. Blowdown water is produced as a result of the evaporation of water in the cooling tower. Evaporation causes the mineral content of the remaining water that does not evaporate to increase. Blowdown is produced by draining water with high mineral concentrations from the cooling tower and replacing it with fresh water. Blowdown from Unit 5 cooling towers does not contribute heat to the CCS. At 10,000 gallons per day (gpd) (38 m^3/day), the volume of blowdown water discharged from Unit 5 to the CCS is relatively small.

3.1.3.2 Cooling Canal System (CCS)

This section describes the physical dimensions of the CCS and its operation.

<u>Layout of the Cooling Canal System</u>

The CCS covers an area approximately 2-mi (3.2-km) wide by 5-mi (8-km) long and covers an area of approximately 5,900 ac (24 km^2). It was built to act as a cooling reservoir for Units 1, 2, 3, and 4 and as an industrial wastewater facility for liquid discharges from all operations at the Turkey Point site. As previously described, while water from the CCS is circulated through Units 1 and 2, only Units 3 and 4 now use the CCS for cooling. The CCS receives heated water from Units 3 and 4 and distributes the water into 32 feeder channels (canals). Water in the feeder channels flows south into a single collector channel that distributes water to seven return channels (Figure 3-4). As the water flows through the channels, heat is lost, largely through evaporation. Water in the return channels flows north where it is used to cool Units 3 and 4. Units 3 and 4 return heated water to the CCS to repeat the cycle. Flows through the CCS are approximately 1.3 million gallons per minute (gpm) (4.9 million liters per minute (Lpm)) (FPL 2018f).

Prior to the construction of Units 3 and 4, the cooling system for Units 1 and 2 used a cooling system with a once-through design. It withdrew water from and discharged water to Biscayne Bay. However, a 1971 consent decree by the Federal District Court for the Southern District of Florida (United States v. Florida Power and Light Company) required FPL to discharge all cooling water from Turkey Point facilities into a closed-cycle cooling canal system. To comply with this decree, FPL designed and constructed the CCS and ensured that it had no surface water connection to any outside water body (i.e., Biscayne Bay or Card Sound) (NRC 2016a). The CCS then replaced the previous Units 1 and 2 once-through cooling system.

The CCS consists of 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 built up above the land surface; instead, it was excavated 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., below the top of the Biscayne aquifer). Therefore, the limestone rock of the Biscayne aquifer forms the bottom and sides of the CCS.

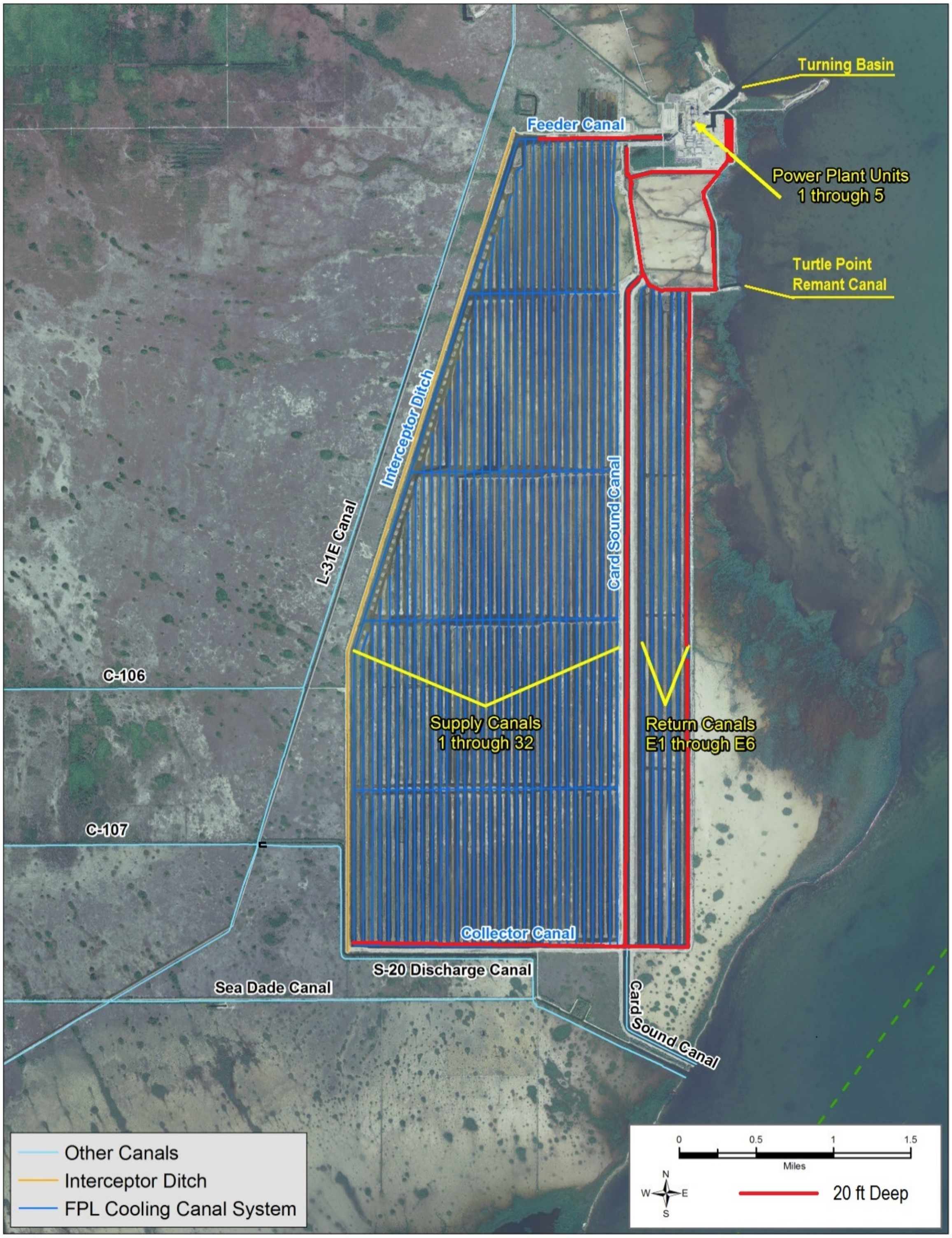
Perimeter berms surround the CCS. These berms are constructed on top of the bedrock and do not contact the water in the CCS. They vary in height from 4 to 10 ft (1.2 to 3 m) above the surface of the bedrock. The widths of the perimeter berms vary from 25 feet to well over 100 feet (7.6 m to 30.5 m) with an average width of more than 50 ft (15.2 m). The perimeter berms are not in contact with water within the CCS. As mentioned previously, the water in the CCS is below the top of the bedrock, while the perimeter berms are built on top of the bedrock. The berms are not designed and built to contain CCS water; rather, these berms are designed and built to prevent surface water from entering 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). The average canal depth is 2.8 ft (0.85 m) (FPL 2018f). They are separated by 90 foot (27 m) wide berms (NRC 2002c). A few of the channels within the CCS have been excavated to a depth of approximately 20 ft (6.1 m). These deep channels are:

- The east-west distribution channel along the north side of the CCS
- The east-west collection channel along the south side of the CCS
- The north-south channel within the CCS, originally built to discharge water to Card Sound
- The north-south channel along the east side of the CCS
- A few channels in the northeast corner of the CCS that connect to the intake basin (Golder 2008, Morgan & Eklund 2010)

When the CCS was constructed, the previous canals that functioned as intake and discharge canals into Biscayne Bay or Card Sound were either incorporated into the CCS or excluded from it. Those previous canals that were excluded from the CCS have now become remnant dead-end canals. The Barge Turning Basin in Biscayne Bay was walled off from the CCS. Earthen plugs were installed between the CCS and the remnant dead end canals. Within the plugs in the Turtle Point remnant canal that connects to Biscayne Bay and in the Card Sound remnant canal that connects to Card Sound (see Figure 3-4), cement and bentonite slurry walls have been constructed to prevent water seepage through them. In addition, both sides of these plugs are protected with a layer of limestone rock to prevent surface erosion of the plug. The Turtle Point remnant canal plug varies in width from 25 to 40 ft (7.6 to 12 m) and the Card Sound remnant canal plug varies in width from 25 to 50 ft (7.6 to 15 m) (FPL 2016f).

In addition to the channels (canals) within the CCS, an interceptor ditch is located outside and against the west side of the CCS. The ditch is not connected to the CCS or other surface waters. However, it is a part of CCS operations. It parallels the entire length of the west side of the CCS. It is constructed to a depth of approximately 18 ft (5.5 m) (Golder 2008). The purpose of the interceptor ditch is to limit the amounts of saline groundwater that move from beneath the CCS to areas west of the Canal L-31E Levee, to those amounts which would have moved to those areas if the CCS did not exist (Figure 3-4) (FPL 2018f).



Source: Modified from SFWMD 2011a

Figure 3-4 Cooling Canal System and Adjacent Canals

Depending on the head levels (water levels) in the Biscayne aquifer relative to the head levels in Biscayne Bay, groundwater beneath and around the Turkey Point site can either flow towards the bay (east) or inland away from the bay (west). During wet times of the year, when groundwater levels are high, groundwater flow is usually towards the bay. During dry times of the year, when groundwater levels are low, groundwater flow is usually inland away from the bay.

When surface water and groundwater monitoring data around the Turkey Point site indicate that there is a potential for groundwater to flow inland (west), water is pumped from the interceptor ditch and discharged into the CCS. This causes near-surface groundwater to flow towards the interceptor ditch and captures near-surface groundwater below the CCS that is moving west (FPL 2018f). The capture effect is likely limited to the depth of the interceptor ditch, which, at a depth of about 18 ft (5.5 m), is a little deeper than the bottom of the L-31E Canal (Golder 2008).

Cooling Canal System Operation

Units 3 and 4 discharge heated water into the CCS. As this water travels through the length of the CCS, it loses heat through evaporation. Evaporation not only removes heat from the water in the CCS, but it also removes some of the water. Water lost through evaporation is replaced by three main sources. The single largest contributor of new water to the CCS is water from precipitation (e.g., rain). Historically, the second largest contributor has been saltwater from the Biscayne aquifer that seeps into the CCS through the limestone bedrock. However, more recently, a different water source has likely overtaken Biscayne aquifer seepage as the second largest contributor of new water to the CCS. Specifically, as further discussed in Section 3.5.2.3, “Groundwater Use,” brackish water supplied by FPL’s wells that withdraw water from the Floridan aquifer is likely a larger contributor of new water to the CCS than is provided by the seepage of water from the Biscayne aquifer.

The CCS receives relatively minor additions of water from discharges from the interceptor ditch and Unit 5 cooling tower blowdown. In extraordinary circumstances, FPL may add water to the CCS from wells (marine wells near Biscayne Bay) that withdraw saltwater from the Biscayne aquifer (see Section 3.5.2.3 for more detail). However, FPL seldom uses these marine wells (FPL 2018f).

As mentioned earlier in this chapter, 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 in the perimeter of the CCS. These plugs seal off remnant canals from the water in the CCS (FPL 2018f). 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 likely pathway for water to seep from the CCS as they are not in contact with the CCS water.

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

Sediments can build up in the channels of the CCS. These sediments can obstruct the lateral flow of water through the CCS and can also lower the rate of water movement into the CCS from the Biscayne aquifer. Therefore, CCS maintenance activities include the removal of accumulated sediments as required to maintain adequate water flow in the CCS (FPL 2018f).

3.1.3.3 Auxiliary Cooling Water System

In addition to the cooling water loop, heat is also removed from Turkey Point operations by the auxiliary cooling water system. This system is much smaller in its water requirements than the cooling water loop. Auxiliary cooling water systems can include emergency core cooling systems, containment spray and cooling systems, emergency feedwater systems, component cooling water systems, and spent fuel pool water systems. At Turkey Point, the auxiliary cooling water system consists of three loops: (1) the component cooling loop, (2) the residual heat removal loop, and (3) the spent fuel pit cooling loop. These loops obtain water from the Miami-Dade County public water supply system and discharge water to the CCS.

3.1.3.4 Fire Protection Water System

Fire protection water protects the plant in the event of a fire. At Turkey Point, the Miami-Dade County public water supply system supplies the fire protection water as described below.

3.1.3.5 Potable Water System

Turkey Point uses approximately 1 mgd (3,800 m^3/day of water from the Miami-Dade County public water supply system. However, a water treatment plant, which supplies pure water for steam-related use, was completed in 2017. This new plant has the ability to treat brackish water at a rate of more than 1 mgd (3,800 m^3/day from onsite wells that withdraw water from the Upper Floridan aquifer (see Section 3.5.2.3, “Groundwater Use”). This will significantly reduce the volume of potable water that FPL needs to obtain from the Miami-Dade County public water supply system.

Potable water is used by the auxiliary cooling water system, fire protection system, and drinking water system. Turkey Point discharges treated waste-process waters into the CCS, and domestic wastewater is sent to an onsite sewage treatment plant. After treatment, FPL disposes of water from the sewage treatment plant into the Biscayne aquifer through an injection well. Beneath the Turkey Point site, the Biscayne aquifer contains saltwater (see Section 3.5.1.4, “Adjacent Surface Water Quality and Cooling Canal System Operation”).

3.1.4 Radioactive Waste Management Systems

As a result of normal operations, equipment repairs and replacements, and normal maintenance activities, nuclear power plants routinely generate both radioactive and nonradioactive waste. Nonradioactive waste includes hazardous and nonhazardous waste. There is also a class of waste—called mixed waste—which is both radioactive and hazardous. This section describes the systems that FPL uses to manage (i.e., treat, store, and dispose of) these wastes. This section also discusses other waste minimization and pollution prevention measures commonly employed at nuclear power plants.

The NRC licenses all nuclear plants with the expectation that they will release some radioactive material to both the air and water during normal operations. However, NRC regulations require that gaseous and liquid radioactive releases from nuclear power plants must meet radiation dose-based limits specified in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, “Standards for Protection Against Radiation,” and the as-low-as-is-reasonably-achievable

(ALARA) criteria in 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." In other words, the NRC places regulatory limits on the radiation dose that members of the public can receive from a nuclear power plant's radioactive effluents. For this reason, all nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

Turkey Point uses the waste disposal system, as needed, to collect and process radioactive materials contained in liquid, gaseous, and solid waste produced as a byproduct of plant operations. The waste disposal system ensures that the dose to members of the public from radioactive effluents is reduced to levels that are ALARA in accordance with the NRC's regulations.

Under an agreement between FPL and the Florida Department of Health (DOH), the DOH Bureau of Radiation Control conducts the Turkey Point radiological environmental monitoring program (REMP). Through the REMP, the Bureau of Radiation Control documents the radiological impact, if any, to the public, site employees, and the environment from radioactive effluents released during operations at Turkey Point. Section 3.1.4.5 below discusses the REMP in more detail.

FPL uses its Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters for calculating offsite doses resulting from liquid and gaseous radioactive effluents. These methods ensure that radioactive material discharges from Turkey Point meet NRC and U.S. Environmental Protection Agency (EPA) regulatory dose standards. The ODCM also contains the requirements for the REMP (FPL 2018f).

3.1.4.1 Radioactive Liquid Waste Management

FPL uses waste management systems to collect, analyze, and process radioactive liquids produced at Turkey Point. These systems reduce radioactive liquids before they are released to the environment. The Turkey Point Units 3 and 4 waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I, and controls the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes.

The plant collects liquid radioactive waste in sumps and tanks in the waste disposal system. Plant personnel then sample and analyze these collected liquid wastes to determine the level of radioactivity and to determine if subsequent treatment is necessary. Personnel then process the liquid radioactive wastes as required by 10 CFR Part 20 and release them into the CCS discharge streams. FPL uses radiation monitors and applies safety features for the discharge stream to avoid releases in excess of 10 CFR Part 20 standards (FPL 2016i).

Radioactive liquid waste entering the waste holdup tanks (WHT) via gravity feed include effluents from the chemistry laboratories, containment sumps, floor drains, showers, and other miscellaneous sources which flow to waste and monitoring holdup tanks. The laundry waste is segregated into one of two monitor tanks. In addition, other sources of liquid wastes include Turkey Point steam generator blowdown and storm drains. These liquids are then pumped to the waste monitor tank where the activity level is determined and recorded prior to discharge through the radiation monitor. The chemical and volume control system (CVCS) receives radwaste liquids from the reactor coolant loop drains, accumulators, and excess letdown.

According to FPL's environmental report submitted as part of the subsequent license renewal application, liquid requiring cleanup before being discharged to the environment is processed by the waste disposal demineralizer. Turkey Point routes the liquid from the waste disposal demineralizer directly to one of the three radwaste facility waste monitor tanks or one of two waste disposal system monitor tanks (FPL 2016i, Section 11.1.2). When one of the waste monitor tanks is filled, it is isolated, recirculated, and sampled for analysis while one of the other two tanks is in service. If analysis confirms the activity level is suitable for discharge, the liquid is pumped through a flow meter and a radiation monitor and then released to the cooling canals of the industrial wastewater facility. Otherwise, it can be returned to a waste holdup tank for reprocessing (FPL 2016i, Section 11.1.2). Turkey Point monitors radioactive liquid discharge from its systems to ensure that activity concentrations do not exceed regulatory limits.

FPL's use of these radioactive waste systems and the procedural requirements in the Offsite Dose Calculation Manual ensure that the dose from radioactive liquid effluents at Turkey Point complies with NRC and EPA regulatory dose standards.

FPL calculates dose estimates for members of the public using radioactive liquid and gaseous effluent release data and atmospheric and aquatic transport models. Unit 3 and Unit 4 share the liquid waste treatment system. Generally, FPL allocates all liquid releases on a 50/50 basis to each unit. In addition, both units also share the gaseous releases from the shared gaseous waste treatment system on a 50/50 basis. Turkey Point's annual radioactive effluent release reports contain a detailed presentation of the radioactive liquid and gaseous effluents released from Turkey Point and the resultant calculated doses. The NRC staff reviewed 5 years of radioactive effluent release data from 2013 through 2017 (FPL 2013b, 2014d, 2015a; 2016l, FPL 2017e). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation of radioactive effluents. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (e.g., increasing dose levels) over the period spanning from 2013 through 2017. Since the radioactive liquid effluents are released from common areas shared by both Unit 3 and Unit 4, the resultant calculated doses presented in the effluent release are divided in half to evaluate compliance with the Appendix I to 10 CFR Part 50 dose criteria. The NRC staff's review of Turkey Point's radioactive liquid effluent control program showed that radiation doses to members of the public were controlled within the NRC's and EPA's radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190. No adverse trends were observed in the dose levels. Routine plant refueling and maintenance activities currently performed will continue during the license renewal term. Based on the past performance of the radioactive waste system to maintain doses from radioactive liquid effluents to be ALARA, similar performance is expected during the license renewal term. The following summarizes the calculated doses from radioactive liquid effluents released from Turkey Point Units 3 and 4 during the most recent available year (2017):

Turkey Point Unit 3 in 2017

- The total-body dose to an offsite member of the public from Turkey Point Unit 3 radioactive effluents was 2.38×10^{-4} millirem (mrem) (2.38×10^{-6} millisievert (mSv)), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ dose (gastrointestinal tract) to an offsite member of the public from Turkey Point Unit 3 radioactive effluents was 2.76×10^{-4} mrem (2.76×10^{-6} mSv), which is well below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50.

Turkey Point Unit 4 in 2017

- The total-body dose to an offsite member of the public from Turkey Point Unit 4 radioactive effluents was 2.38×10^{-4} millirem (mrem) (2.38×10^{-6} millisievert (mSv)), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ dose (gastrointestinal tract) to an offsite member of the public from Turkey Point Unit 4 radioactive effluents was 2.76×10^{-4} mrem (2.76×10^{-6} mSv), which is well below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50.

The NRC staff's review of FPL's radioactive liquid effluent control program shows that the applicant maintained radiation doses to members of the public that were within NRC's and EPA's radiation protection standards in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and Title 40, "Protection of Environment," of the *Code of Federal Regulations* (40 CFR) Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." The NRC staff observed no adverse trends in the dose levels.

Routine plant refueling and maintenance activities at Turkey Point will continue during the subsequent license renewal term. Based on FPL's past performance in operating a radioactive waste system at Turkey Point that maintains ALARA doses from radioactive liquid effluents, the NRC staff expects that FPL will maintain similar performance during the subsequent license renewal term.

3.1.4.2 Radioactive Gaseous Waste Management

Radioactive gaseous waste generated at Turkey Point is collected, processed, and stored until its radioactivity level is low enough to permit discharge to the environment at concentrations below 10 CFR Part 20 standards (FPL 2016i, Section 1.2.4) through the waste disposal system. Sources of the radioactive gaseous waste at Turkey point include gas decay tanks, containment purges, the refueling water storage tank via the vent line, the Turkey Point equipment hatch during outages, and releases incidental to plant operations. This radioactive gaseous waste is created during plant operation from degassing reactor coolant discharge to the chemical and volume control system, displacement of cover gases, miscellaneous equipment vents, relief valves, and sampling operation and gas analysis for hydrogen and oxygen in cover gases. Most of the gas received by the waste disposal system is cover gas displaced from the chemical and volume control system holdup tanks as they fill with liquid. Gaseous waste is stored in decay tanks for natural decay and is then released through the monitored plant vent. The cover gas is reused to minimize the number of tank releases. The gaseous waste is monitored and released at a permissible rate and activity as prescribed by the ODCM. Radioactive gaseous effluents from Turkey Point Units 3 and 4 are released through four monitored release points: a common plant vent via a stack above the containment building (~200 feet), the Unit 3 spent fuel pit vent (~110 feet), and the condenser air ejector vents (~51 feet) from each unit.

Gases that are vented to the vent header flow to the waste gas compressor suction header. One of two compressors is in continuous operation with the second unit instrumented to act as backup for peak load conditions or failure of the first compressor. From the compressors, gas flows to one of the gas decay tanks. Gas held in the decay tanks can either be returned to the chemical and volume control system holdup tanks or discharged to the atmosphere via the plant vent at a controlled rate through a radiation monitor if it has decayed sufficiently for release (FPL 2016i, Section 11.1.2). The gases in the tanks are sampled and analyzed to determine the radioactivity level. The radioactivity level contained in each gas decay tank is restricted

(1) to ensure that if an uncontrolled release of the tank's contents were to occur, the resulting total body exposure to an individual at the exclusion area boundary would not exceed 500 mrem/yr (5 mSv/yr) and (2) to control the concentration of potentially explosive gases to below flammability limits. The decay tanks are used to contain the compressed waste gases (hydrogen, nitrogen, and fission gases) until they decay and are ready to be vented to the atmosphere.

FPL's use of this gaseous radioactive waste system and adherence to the procedural requirements in the ODCM ensure that the dose from radioactive gaseous effluents complies with NRC and EPA regulatory dose standards.

As discussed above, FPL calculates dose estimates for members of the public using radioactive liquid and gaseous effluent release data and atmospheric and aquatic transport models. Unit 3 and Unit 4 share the gaseous waste treatment system. The following summarizes the calculated doses from radioactive gaseous effluents released from Turkey Point during 2017:

Turkey Point Unit 3 in 2017

- The air dose at the site boundary from gamma radiation in gaseous effluents from Turkey Point Unit 3 was $1.30{\times}10^{-5}$ millirad (mrad) ($1.3{\times}10^{-7}$ milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Appendix I to 10 CFR Part 50.
- The air dose at the site boundary from beta radiation in gaseous effluents from Turkey Point Unit 3 was $2.96{\times}10^{-5}$ mrad ($2.96{\times}10^{-7}$ milligray) dose which is well below the 20 mrad (0.2 milligray) dose criterion in Appendix I to 10 CFR Part 50.
- The dose to an organ (thyroid) from radioactive iodine, radioactive particulates, and carbon from Turkey Point Unit 3 was $1.01{\times}10^{-1}$ mrem ($1.01{\times}10^{-3}$ mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50.

Turkey Point Unit 4 in 2017

- The air dose at the site boundary from gamma radiation in gaseous effluents from Turkey Point Unit 4 was $9.02{\times}10^{-6}$ mrad ($9.02{\times}10^{-8}$ milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Appendix I to 10 CFR Part 50.
- The air dose at the site boundary from beta radiation in gaseous effluents from Turkey Point Unit 4 was $2.07{\times}10^{-5}$ mrad ($2.07{\times}10^{-7}$ milligray) dose which is well below the 20 mrad (0.2 milligray) dose criterion in Appendix I to 10 CFR Part 50.
- The dose to an organ (thyroid) from radioactive iodine, radioactive particulates, and carbon from Turkey Point Unit 4 was $1.19{\times}10^{-1}$ mrem ($1.19{\times}10^{-3}$ mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50.

The NRC staff's review of Turkey Point's radioactive gaseous effluent control program showed radiation doses to members of the public that were well below NRC and EPA radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190. The NRC staff observed no adverse trends in the dose levels.

Routine plant refueling and maintenance activities at Turkey Point will continue during the subsequent license renewal term. FPL's past performance operating the radioactive waste system demonstrates that it is able to maintain ALARA doses from radioactive gaseous effluents. Based on this record of past performance, the NRC staff expects that FPL will maintain similar performance during the subsequent license renewal term.

3.1.4.3 Radioactive Solid Waste Management

At Turkey Point, low-level radioactive wastes (LLRW) are packaged and stored for subsequent shipment and offsite burial under the plant's waste disposal system. FPL packages Turkey Point radioactive waste shipments in accordance with NRC requirements (10 CFR Part 71, "Packaging and Transportation of Radioactive Material"), and U.S. Department of Transportation (USDOT) requirements (Title 49, "Transportation," of the *Code of Federal Regulations* Part 173, "Shippers—General Requirements for Shipments and Packagings," and Part 178, "Specifications for Packagings").

Under the waste disposal system, FPL packages all solid wastes in high-integrity containers (HICs) for removal to disposal facilities. The HICs are designed to be placed into transfer casks for shipment offsite for disposal. The HICs are also designed to be stored in the LLRW storage facility while awaiting shipment offsite for disposal. The waste disposal system has been designed as a waste process system, which includes demineralizers, monitor tanks, a condensate tank, and associated pumps. Solid radioactive waste and potentially radioactive wastes include spent resins, spent filters, and miscellaneous materials. Solid radioactive wastes also include solids recovered from the reactor coolant system (RCS), solids in contact with the liquids or gases associated with the reactor coolant process systems, and solids used in support of the reactor coolant system operation. The largest volume of solid radioactive waste is LLRW, which includes bead resin, spent filters, and dry active waste from outages and routine maintenance. Turkey Point has developed long-term plans which ensure that radioactive waste generated during the subsequent license renewal term will be sent directly for disposal, stored onsite in existing structures, or shipped to an offsite licensed facility for processing and disposal (FPL 2018f).

LLRW is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both dry active waste and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated hardware. The majority of LLRW generated at Turkey Point during the subsequent license renewal period is expected to be Class A waste and could be shipped to licensed processors, such as the Energy Solutions facility in Oak Ridge, TN, for reduction and repackaging, and then shipped to a Class A disposal facility such as the Energy Solutions facility in Clive, UT. Class B and C wastes would constitute a low percentage by volume of the total LLRW generated. The LLRW storage facility at Turkey Point can currently store approximately 5 years of Class B and Class C wastes.

Class B and C wastes can be shipped to the Energy Solutions facility in Oak Ridge, TN, where they can then be shipped to the Waste Control Specialist facility in Texas, which is licensed for disposal of Classes A, B, and C wastes. Disposal of waste greater than Class C is the responsibility of the Federal Government. The NRC licenses the storage of LLRW waste under the general license provided to power reactor licensees under 10 CFR Part 50 (FPL 2016f).

In 2017, a total of eight LLRW shipments were made from Turkey Point to the Energy Solutions, Bear Creek Road Facility (Oak Ridge, TN) (FPL 2018f) and Energy Solutions, Gallaher Road Facility (Kingston, TN) (FPL 2018f). The total volume and radioactivity of LLRW shipped offsite in 2017 was 6.00×10^{2} cubic meters (m^3) (2.12×10^{4} cubic feet (ft^3)) and 1.11×10^{0} curies (Ci) (4.12×10^{4} megabecquerels (MBq)), respectively (FPL 2018f). During the subsequent license renewal period, Turkey Point would continue with routine plant operation, refueling outages, and maintenance activities that generate radioactive solid waste. The NRC also expects Turkey Point to continue to ship radioactive solid waste offsite for disposal during the subsequent license renewal period.

3.1.4.4 Radioactive Waste Storage

At Turkey Point, LLRW is stored temporarily onsite before being shipped offsite for treatment or disposal at licensed LLRW treatment and disposal facilities. In its environmental report for the Turkey Point subsequent license renewal application, FPL states that Turkey Point has sufficient existing capability to store LLRW onsite. FPL also states in its environmental report that its long-term needs for generated LLRW storage (including during the subsequent license renewal term) do not require constructing additional onsite storage facilities (FPL 2018a).

Turkey Point stores its spent fuel in a spent fuel pool and in an onsite independent spent fuel storage installation (ISFSI). The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers.

If the U.S. Department of Energy does not begin to take possession of the spent nuclear fuel in 2031, FPL may need to expand the existing capacity of the Turkey Point Units 3 and 4 ISFSI. This would require FPL to construct a new ISFSI pad to accommodate additional spent nuclear fuel generated during the subsequent license renewal term (FPL 2018g). Alternatively, FPL may choose to utilize a higher density storage system to create additional storage capacity and, thereby, reduce the need to expand the ISFSI. At this time, FPL has not yet determined whether to expand the ISFSI.

3.1.4.5 Radiological Environmental Monitoring Program

As stated above, the Florida Department of Health (DOH) Bureau of Radiation Control, per an agreement between FPL and the DOH, conducts a radiological environmental monitoring program (REMP) to assess the radiological impact, if any, to the public and the environment from the operations at Turkey Point Units 3 and 4.

The REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity. Monitoring is conducted for the following: direct radiation, air, water, groundwater, broad leaf vegetation, fish, shellfish, and sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon).

In addition to the REMP, Turkey Point has an onsite groundwater protection program designed to monitor the onsite plant environment for detection of leaks from plant systems and pipes containing radioactive liquid (FPL 2018f). Information on the groundwater protection program is contained in Section 3.5.2, “Groundwater Resources,” of this SEIS.

FPL states in its environmental report that it has detected tritium in groundwater but has not detected Turkey Point Units 3 and 4-related gamma-emitting isotopes since establishing its NEI 07-07, “Industry Ground Water Protection Initiative,” program (FPL 2018f). Section 3.5.2 provides a summary of radionuclides detected in groundwater. For 2017, the highest observed level of tritium in Turkey Point groundwater was reported as 13,600 pCi/L. For comparison, the EPA primary drinking water standard or maximum contaminant level (MCL) for tritium is 20,000 pCi/L (40 CFR 141.16). Tritium is also found in surface water onsite. For 2017, the maximum level measured was 24,483 pCi/L in the CCS. While some tritium levels measured in the CCS were found to be higher than the EPA drinking water standard of 20,000 pCi/L, they were still lower than the limits prescribed by Turkey Point Unit 3 and 4’s Offsite Dose Calculation Manual (FPL 2013a) for the plant, which for tritium is 30,000 pCi/L. Further, no surface water or groundwater at the site is used for potable purposes.

The NRC staff reviewed 5 years of annual radiological environmental monitoring data from 2013 through 2017 (FPL 2014c, FPL 2015b, FPL 2016j, FPL 2017d, FPL 2018k). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (e.g., increasing radioactivity levels) over the period of 2013 through 2017.

Based on its review of this information, the NRC staff found no apparent increasing trend in concentration or pattern indicating either a new inadvertent release or persistently high tritium concentrations that might indicate an ongoing inadvertent release from Turkey Point Units 3 and 4. The groundwater monitoring program at Turkey Point Units 3 and 4 is robust, and any future leaks that might occur during the subsequent license renewal period should be readily detected. All spills are well monitored, characterized, and actively remediated. The data show that there were no significant radiological impacts to the environment from operations at Turkey Point Units 3 and 4.

3.1.5 Nonradioactive Waste Management Systems

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals.

Turkey Point has a nonradioactive waste management system to handle its nonradioactive hazardous and nonhazardous wastes. The waste is managed in accordance with FPL’s procedures. Turkey Point has a contact stabilization treatment plant for sanitary waste (FPL 2018f) which is located west of the power block area. The treated wastewater is disposed of through an approximately 25-cm (10-in.) diameter, 15-m (50-ft) deep underground injection well located adjacent to the treatment facility. FPL disposes of residuals (wet sludge) at the Miami-Dade Water and Sewer Department’s (MDWSD) South District Wastewater Treatment Facility (FPL 2018f).

The Miami-Dade County Department of Solid Waste Management is responsible for solid waste collection, transport, and disposal in unincorporated portions of the county and in eight municipalities. The Department of Solid Waste Management solid waste disposal system consists of a resource recovery waste-to-energy facility and two landfills: (1) the North Dade Landfill (a trash-only facility) and (2) the South Dade Landfill (a garbage and trash facility), which are supported by three regional waste transfer stations. An approved solid waste contractor collects and transports the solid waste generated at Turkey Point for disposal at county facilities (FPL 2018f). Listed below is a summary of the types of waste materials generated and managed at Turkey Point.

- Turkey Point is classified as a small quantity, hazardous waste generator. The amounts of hazardous wastes generated are only a small percentage of the total wastes generated. These wastes consist of paint wastes; spent, off-specification, and shelf-life expired chemicals; and occasional project-specific wastes (FPL 2018f).

- Turkey Point's nonhazardous wastes include plant trash and nonradioactive waste (FPL 2018f).
- Other wastes include fluorescent lamps, batteries, and devices containing mercury; electronics; and antifreeze (FPL 2018f).

For the fossil fuel facilities (Units 1 and 2, and Unit 5) and the Turkey Point site land management facilities, FPL routes sanitary waste from showers, water closets, toilets, etc. to Miami-Dade County-approved onsite septic systems. For the nuclear generating Units 3 and 4, FPL routes domestic wastewater to an onsite, county- and State-permitted, contact stabilization sewage treatment plant. This wastewater treatment plant (WWTP) discharges effluents to an onsite, permitted, single Class V, Group 3 gravity underground injection well used to dispose of domestic wastewater effluent (FPL 2018f). Wastewater residuals generated by this plant are transported to an approved offsite facility (FPL 2018f). The clarified wastewater sludge is monitored according to operational protocol 0-NCAP-103 to ensure that the disposed material does not present an environmental or public health risk.

3.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at a nuclear power plant typically interfaces with the public infrastructure systems available in the region. Such public infrastructure includes utilities, such as suppliers of electricity, fuel, and water, as well as roads and railroads that provide access to the site. The following sections briefly describe the existing utility and transportation infrastructure at Turkey Point. Unless otherwise cited, the source of the Turkey Point site-specific information in this section is FPL's environmental report submitted as part of the subsequent license renewal application (FPL 2018f).

3.1.6.1 Electricity

Nuclear power plants generate electricity for other users; however, they also use their own generated electricity to operate. In the event of a malfunction or interruption of onsite nuclear power generation at Turkey Point, the facility would depend on offsite power sources to provide power to engineered safety features and emergency equipment. If both Turkey Point nuclear power generation and offsite power sources fail, the facility will use planned independent backup power sources.

3.1.6.2 Fuel

Under its current renewed facility operating licenses, Turkey Point Units 3 and 4 are licensed for fuel that is slightly enriched uranium dioxide (up to 5.0 percent by weight uranium-235). FPL operates the reactors at an equilibrium core maximum fuel discharge burnup rate of 62,000 megawatt-days per metric ton uranium (MWd/MTU). FPL refuels each nuclear unit on an 18-month schedule, which means at least one refueling every year and two refuelings every third year. FPL loads the core fuel in three regions. New fuel is introduced into the outer region, and partially spent fuel is moved inward into a checkerboard pattern at successive refuelings when the inner region fuel is discharged to spent fuel storage (FPL 2018f).

The Turkey Point spent fuel storage pit provides underwater storage of spent fuel assemblies and control rods after their removal from the reactor. The spent fuel pit is located in the auxiliary building and can store up to 1,535 fuel assemblies, including 131 spent or fresh fuel assemblies in the cask area rack, as well as miscellaneous fuel handling tools. FPL designed the cask area of the spent fuel pit for the installation of a fuel transfer cask to allow fuel transfer operations. The Turkey Point site has an ISFSI to provide Unit 3 and Unit 4 spent fuel capacity (FPL 2018f).

3.1.6.3 Potable Water

In addition to cooling and auxiliary water (previously described in detail in Section 3.1.3), nuclear power plants require potable water for sanitary and everyday uses by personnel (e.g., drinking, showering, cleaning, laundry, toilets, and eye washes). At Turkey Point, the Miami-Dade County public water supply system supplies potable water to the site.

3.1.6.4 Transportation Systems

All nuclear power plants are served by controlled access roads. In addition to roads, many plants also have railroad connections for moving heavy equipment and other materials. Plants located on navigable waters may have facilities to receive and ship loads on barges.

The Turkey Point site transportation network includes U.S. highways, interstate highways, multilane divided State highways, and local streets. Miami-Dade County operates public transportation services including rail and bus service. Miami-Dade County also offers air transportation infrastructure including airports, heliports, and a seaplane base; a seaport for commercial freight and passenger service; and an intermodal transportation hub for air, rail, and ship (FPL 2018f). Section 3.10.6, "Local Transportation," describes these systems in more detail.

3.1.6.5 Power Transmission Systems

For license renewal, including subsequent license renewal, the NRC (2013b) evaluates as part of the proposed action the continued operation of those power transmission lines that connect the nuclear power plant to the substation where it feeds electricity into the regional power distribution system. The NRC also evaluates the continued operation of the transmission lines that supply outside power to the nuclear plant from the grid. In its environmental report, FPL stated the locations of in-scope transmission lines, which are shown in Figure 3-5 (FPL 2018f). Turkey Point is connected to the 230-kV switchyard through an approximately 590-foot (180-m) transmission line (FPL 2018f).

Figure 3-5 Turkey Point In-Scope Transmission Lines (FPL 2018f)

3.1.7 Nuclear Power Plant Operations and Maintenance

FPL's Turkey Point maintenance activities include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. Various programs and activities are currently in place at Turkey Point to maintain, inspect, and monitor the performance of facility structures, systems, and components. These activities include, but are not limited to, (1) in-service inspections of safety-related structures, systems, and components, (2) quality assurance program, (3) fire protection program, and (4) monitoring of radioactive and nonradioactive water chemistry.

Additional Turkey Point maintenance programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications. Such additional programs include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. FPL performs certain program activities during the operation of the units and performs others during scheduled refueling outages. As stated above, reactor refueling at Turkey Point occurs on an 18-month cycle (FPL 2018f).

3.2 Land Use and Visual Resources

Section 2.2.1 of NUREG–1437, Supplement 5 (the SEIS for the Turkey Point's initial license renewal) describes the general land use at Turkey Point Units 3 and 4 (NRC 2002c). This information is incorporated here by reference. Section 2.2 of NUREG-2176, "Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7" (NRC 2016a), also describes the land use at the Turkey Point site. This information is also incorporated here by reference (NRC 2016a). No new and significant information was identified during the review of FPL's environmental report for the Turkey Point Units 3 and 4 subsequent license renewal (FPL 2018f), during the site audit at Turkey Point, the scoping process, or the evaluation of other available information that would alter the discussion contained in the SEIS for Turkey Point's initial license renewal.

3.2.1 Land Use

Turkey Point Units 3 and 4 are located on the shore of Biscayne Bay in south Florida's Miami-Dade County. The plant site is approximately 25 mi (40 km) south-southwest of Miami. The nearest incorporated city limits are Homestead, which is approximately 9 mi (14.5 km) west-northwest of the plant site, and Florida City, which is approximately 9 mi (14.5 km) west of the plant site. The nearest community to the south is Key Largo, which is in Monroe County, FL and is approximately 30 mi (48 km) by road from the plant site.

3.2.1.1 Onsite Land Use

Turkey Point Units 3 and 4 and associated structures and features, including the cooling canal system, occupy approximately 8,000 ac (3,200 ha). The largest land use and land cover categories within the Turkey Point property boundary are wetlands and open water, which together compose approximately 93 percent of the site. The next largest land use category is developed land (to support Turkey Point plant operations), which is approximately 6 percent of the site (FPL 2018f).

Miami-Dade County has designated the land use zoning at the Turkey Point site, including all units, undeveloped lands, and the cooling canal system, as either IU-3 (industrial districts, unlimited manufacturing) or GU (interim district, uses depend on the character of the neighborhood). Specifically, Turkey Point Units 3 and 4 are located on land zoned IU-3. The remainder of the Turkey Point site is zoned GU, an interim district. In an interim district, zoning-assigned land uses depend on the character of the neighborhood; otherwise, EU-2 standards apply (single-family 5-ac estate district) (FPL 2018f).

3.2.1.2 Coastal Zone

Section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA) (16 U.S.C. 1456(c)(3)(A)) requires that applicants for Federal licenses who conduct activities in a coastal zone provide a certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. Turkey Point Units 3 and 4 are within the Florida coastal zone. The Florida Department of Environmental Protection (FDEP) issued a license that constitutes concurrence that FPL's activities at Turkey Point are consistent with the State of Florida's approved coastal management program. The most recent conditions of certification for Turkey Point Units 3 through 5 (PA 03-45) show Turkey Point Units 3 and 4 as being certified to be consistent in 2008, with several modifications since then, the most recent having been issued on March 29, 2016 (FDEP 2016b).

Land to the south and west of the Turkey Point site is in the Everglades Mitigation Bank where wetlands are created, restored, or enhanced to provide compensatory mitigation of wetland losses elsewhere. Under the joint federally and State-operated mitigation bank program, both public and private entities can own lands in the program. FPL owns the Everglades Mitigation Bank land, which comprises approximately 13,000 ac (5,300 ha) of relatively undisturbed freshwater and estuarine wetlands. The U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency (EPA), the Natural Resources Conservation Service, the U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) provide guidance on the use of the mitigation bank to satisfy mitigation requirements of specific laws and provisions, including Section 404 of the Federal Water Pollution Control Act (also known as the Clean Water Act [CWA]) permit program, the wetland conservation provisions of the Food Security Act, the National Environmental Policy Act (NEPA), and several other statutory provisions. The FDEP, the South Florida Water Management District (SFWMD), and Miami Dade County guide the mitigation bank program within Florida pursuant to the Florida Mitigation Banking Rule and other State authorities.

3.2.1.3 Offsite Land Use

Biscayne Bay, located immediately adjacent to Turkey Point, is the predominant natural feature in the vicinity of the Turkey Point site. As described earlier, the largest land use and land cover category at Turkey Point is wetlands and open water, of which open water is the largest component. The next largest land use and land cover category is wetland areas, comprised of woody and emergent herbaceous wetlands. And finally, the third largest land use and land cover category is developed land.

The pattern of land use and urban growth has remained essentially unchanged in Miami-Dade County since 1975, which is when the County released the original Comprehensive Master Development Plan (CMDP). The CMDP establishes a growth policy that encourages development (1) at a rate commensurate with projected county population and economic growth, (2) in a contiguous pattern around a network of high-intensity urban centers connected to transportation facilities, and (3) in locations which optimize efficiency in public service delivery and conservation of valuable natural resources (MDC 2017a).

3.2.2 Visual Resources

The Turkey Point site is relatively flat and sparsely populated with trees. The most visible features are the containment structures for Units 3 and 4. They are the tallest structures on the site at approximately 210 feet (64 m) tall (FPL 2018f). However, trees and other vegetation screen most of Turkey Point Units 3 and 4 and supporting structures from roadways and recreational areas west of the plant site. In addition, vegetation blocks the view of Turkey Point Units 3 and 4 from the Biscayne National Park Dante Fascell Visitor Center and Homestead Bayfront Park, although the units can be clearly seen from other areas of Biscayne National Park, including much of Biscayne Bay. At night, light from Turkey Point is visible from several locations outside the site, including from the Homestead-Miami Speedway and Biscayne Bay (NRC 2016a).

3.3 Meteorology, Air Quality, and Noise

This section describes the meteorology, air quality, and noise environment in the vicinity of Turkey Point.

3.3.1 Meteorology and Climatology

The State of Florida is characterized by a humid subtropical climate, with long, hot summers and short, mild winters. The climate of Florida is largely influenced by the warm waters of the Gulf of Mexico and western Atlantic. Air from the Gulf of Mexico moderates summer heat, shortens winter cold spells, and provides moisture and heavy rainfall during all seasons. Florida is subject to frequent thunderstorms during the summer, and historically, the State experiences the highest annual number of thunderstorms in the United States. The State is also vulnerable to tornados and tropical cyclones (tropical storms and hurricanes) that develop in the Gulf of Mexico and western Atlantic. On average, tropical cyclones strike Florida three times every 5 years, and the Florida coast is vulnerable to severe flooding from these storms (NOAA 2013a, Runkle et al. 2017). Turkey Point is located on the lower east coast of Florida. The general climate in this area is subtropical marine, characterized by a long warm summer with abundant rainfall followed by a mild dry winter (NCDC 2017). The Azores-Bermuda high-pressure system dominates the circulation pattern in this region for most of the year, causing a tropical air mass to prevail. Occasional cold continental air masses displace the maritime air during winter (NRC 2016a).

Section 2.9.1 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NRC 2016a) describes in detail the area’s specific climatological and meteorological conditions including wind, temperature, precipitation, and severe weather. The NRC staff incorporates into this SEIS the information in Section 2.9.1 of the COL EIS by reference. The NRC staff did not identify any new and significant information relevant to the climatological and meteorological environment beyond the information described in the EIS for the Turkey Point Units 6 and 7 combined licenses that would alter the discussion contained in Section 2.9.1 of the COL EIS.

In the past 67 years (1950–2017), the following numbers of severe weather events have been reported in Miami-Dade County (NCDC 2018):

- Hurricane: 10 events
- Tornado: 137 events
- Thunderstorm: 312 events
- Flood: 13 events

3.3.2 Air Quality

Under the Clean Air Act (CAA), 42 U.S.C. 7401, et seq., the EPA has set primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50, “National Primary and Secondary Ambient Air Quality Standards") for six common criteria pollutants to protect sensitive populations and the environment: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). NAAQS further categorize particulate matter under two sizes—PM_{10} (diameter between 2.5 and 10 micrometers) and $PM_{2.5}$ (diameter of 2.5 micrometers or less). Table 3-1 presents the NAAQS for the six criteria pollutants.

Table 3-1 Ambient Air Quality Standards

Pollutant	Averaging Time	National Standard Concentration
Carbon Monoxide (CO)	8-hour	9 ppm (primary standard)
	1-hour	35 ppm (primary standard)
Lead (Pb)	Rolling 3-month average	0.15 μg/m^3
Nitrogen Dioxide (NO_2)	1-hour	100 ppb (primary standard)
	Annual	53 ppb (primary and secondary standard)
Ozone (O_3)	8-hour	0.070 ppm (primary and secondary standard)[(a)]
Particulate matter less than 2.5 μm ($PM_{2.5}$)	Annual	12 μg/m^3 (secondary) 15 μg/m^3 (secondary)
	24-hour	35 μg/m^3 (primary and secondary standard)
Particulate matter less than 10 μm (PM_{10})	24-hour	150 μg/m^3 (primary and secondary standard)
Sulfur Dioxide (SO_2)	1-hour	75 ppb (primary standard)
	3-hour	0.5 ppm (secondary standard)

Key: ppb = parts per billion; ppm = parts per million; μg/m^3 = micrograms per cubic meter. To convert ppb to ppm, divide by 1000.

(a) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone (O_3) standards additionally remain in effect in some areas.

Primary standards provide public health protection, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Source: EPA 2018a

With respect to meeting NAAQS, the EPA designates areas that meet the standards as areas of attainment and areas that do not meet the standards as areas of nonattainment. Areas for which there is insufficient data to determine attainment or nonattainment, the EPA designates as unclassifiable. Areas that once did not meet the standards but now do meet the standards, the EPA calls maintenance areas; maintenance areas are under a 10-year monitoring plan to maintain the attainment designation status. States bear the primary responsibility for ensuring attainment and maintenance under NAAQS. Under Section 110 of the Clean Air Act and related provisions, States must submit, for EPA approval, State implementation plans (SIPs) that provide for the timely attainment and maintenance of the NAAQS.

In Florida, air quality designations are made at the county level. For the purpose of planning and maintaining ambient air quality under NAAQS, the EPA has developed air quality control regions. Air quality control regions are intrastate or interstate areas that share a common airshed. Turkey Point is located in Miami-Dade County, which is part of the EPA's Southeast Florida Intrastate Air Quality Control Region (40 CFR 81.49, "Southeast Florida Intrastate Air Quality Control Region"). This air quality control region consists of eight Florida counties: Broward, Miami-Dade, Indian River, Martin, Monroe, Okeechobee, Palm Beach, and St. Lucie. With respect to meeting NAAQS, EPA designates Miami-Dade County as unclassifiable/attainment or better than national standards for all criteria pollutants (40 CFR 81.310, "Florida"). The nearest designated nonattainment area (for the 2010 sulfur dioxide primary standard) is in Hillsborough County, FL, which is nearly 200 mi (320 km) from Turkey Point.

The Clean Air Act, Title V, "Permits," requires States to develop and implement an air pollution permit program. The FDEP regulates air emissions at Turkey Point under Title V air operation permits (FDEP 2018c, FPL 2018f). Combined Turkey Point Units 1, 3, 4, and 5 are considered one facility for purposes of the Prevention of Significant Deterioration permitting program and Title V operating permits. However, FPL operates these four units under two separate Title V permits: one for fossil fuel Units 1 and 5 (Permit 0250003-025-AV) (Unit 1, which has been retired, was deleted from the permit upon its renewal in November 2018), and another for nuclear Units 3 and 4 (Permit 0250003-028-AV). The FDEP issued Title V Air Operation Permit 0250003-028-AV for Turkey Point Units 3 and 4 in April 2018, and this permit will expire in 2023 (FDEP 2018c). Table 3-2 lists permitted air pollutant emission sources and air permit specified conditions for Turkey Point Units 3 and 4.

Table 3-2 Permitted Air Emission Sources at Turkey Point Units 3 and 4

Equipment	Air Permit Condition
Five emergency diesel engines used to support plant equipment: • Industrial back-up instrument air compressors (2) • Backup service water feed system pump • 10-meter meteorological tower generator • Domestic wastewater system pump	PM, CO, and NO_x limits
One emergency diesel generator engine for the South Dade meteorological tower One emergency diesel fire pump	40 CFR Part 63, Subpart A, (NESHAP General Provisions) and 40 CFR Part 63, Subpart ZZZZ (NESHAP RICE)
Four diesel-engine emergency generators Two emergency diesel engines used to support plant equipment	Unregulated

Key: PM = particulate matter, NO_x = nitrogen oxides, CO = carbon monoxide, NESHAP = National Emission Standards for Hazardous Air Pollutants, RICE = reciprocating internal combustion engines

Source: FDEP 2018c

Table 3-3 shows annual emissions from permitted sources at Turkey Point Units 3 and 4. FPL operates diesel generators/engines at Turkey Point Units 3 and 4 only intermittently (usually during testing or during outages) as these are intended to be used to supply backup emergency power. According to the 2014 National Emissions Inventory, estimated annual emissions in tons per year for Miami-Dade County are approximately 3,650 (sulfur dioxide); 49,600 (nitrogen dioxide); 335,000 (carbon monoxide); 33,000 (particulate matter less than 10 microns); and 86,900 (volatile organic compounds) (EPA 2018b). Turkey Point Units 3 and 4 air emissions from permitted sources make up 0.05 percent or less of Miami-Dade County's total annual emissions. Greenhouse gas emissions from operation of Turkey Point Units 3 and 4 are discussed in Section 4.15.3 of this SEIS.

Table 3-3 Estimated Air Pollutant Emissions from Turkey Point Units 3 and 4

Emissions (tons/year)					
Year	SO_x	NO_x	CO	PM_{10}	VOCs
2012	1.5	16	2.1	1.8	0.8
2013	1.5	15	1.8	1.8	0.7
2014	1.8	19	2.4	2.2	0.9
2015	2.1	21	2.7	2.5	1.0
2016	1.7	17	2.0	2.0	0.8

Key: CO = carbon monoxide, NO_x = nitrogen oxides, SO_x = sulfur dioxides, PM_{10} = particulate matter less than 10 micrometers, VOC = volatile organic compounds
To convert tons per year to metric tons per year, multiply by 0.90718.

Source: FPL 2018f

The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze, which is caused by numerous, diverse air pollutant sources located across a broad region (40 CFR 51.308–51.309). Specifically, 40 CFR Part 81, Subpart D, "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value," lists mandatory Federal areas where visibility is an important value. The Regional Haze Rule requires States to develop state implementation plans to reduce visibility impairment at Class I Federal areas. At Turkey Point, the nearest Class I Federal area is Everglades National Park, approximately 13 mi (21 km) west of Units 3 and 4 (FPL 2018f). Given Turkey Point Units 3 and 4's limited air emissions as presented in Table 3-3, there is little likelihood that ongoing activities at Turkey Point Units 3 and 4 during the subsequent license renewal term would adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) in any Class I Federal areas.

3.3.3 Noise

Section 2.2.8.4 of NUREG–1437, Supplement 5 (the SEIS for the Turkey Point initial license renewal), describes general noise conditions at Turkey Point Units 3 and 4 (NRC 2002c). This information is incorporated here by reference. Section 2.10.2 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NRC 2016a) also describes ambient noise conditions at the Turkey Point site. This information is also incorporated here by reference (NRC 2016a). No new and significant information about noise at the Turkey Point site was identified during the review of available information, including FPL's environmental report for the Turkey Point Units 3 and 4 subsequent license renewal (FPL 2018f), the site visit, or during the scoping process that would alter the discussion contained in the SEIS for Turkey Point's initial license renewal.

FPL conducted a noise survey for the Turkey Point Units 6 and 7 COL application environmental report in June 2008. The survey determined baseline ambient noise conditions near the proposed Turkey Point Units 6 and 7 site (including describing noise from Turkey Point Units 3 and 4) and identified sensitive offsite noise receptors. The nearest sensitive noise receptors included residences to the northwest, a daycare facility to the west, and Homestead Bayfront Park to the north (FPL 2014a).

In general, noise from the Turkey Point site can be detected under certain conditions by visitors in Biscayne National Park. Noise is most noticeable under calm wind conditions or when the wind is blowing lightly from the Turkey Point site to the park. Noise from Turkey Point Units 3 and 4 is generally not an issue at the nearest sensitive noise receptors west of the plant (a daycare facility) due to trees, other vegetation, and attenuation by distance.

3.4 Geologic Environment

This section describes the geologic environment of the Turkey Point site and vicinity, including landforms, geology, soils, and seismic conditions.

3.4.1 Physiography, Geology, and Soils

The land surface at Turkey Point and the area around it is practically flat. Elevations rise from sea level at the site to 10 feet (3 m) mean sea level (MSL) in the Homestead area 9 mi (14.5 km) to the west of Turkey Point. South Florida is underlain by gently dipping or flat-lying sedimentary rocks. In South Florida, these sedimentary rocks are more than 15,000 ft (4,572 m) thick. Limestone is the predominant rock found in the upper 5,000 ft (1,524 m) (FPL 2018f).

The limestone rock is divided into stratigraphic units based on geologic properties. The left side of Figure 3-6 identifies the stratigraphic units beneath Turkey Point down to a depth of greater than 3,030 feet (924 m). For each stratigraphic unit, the figure also includes a brief description of the rock characteristics (lithology), thicknesses, and depth.

The surficial material under Turkey Point consists of engineered fill. The surficial material within the Turkey Point site, which includes Turkey Point Units 1, 2, 3, 4, and 5, and the CCS, consists of either engineered fill, limestone, marl, or muck. Structures and roads are built on engineered fill or limestone. Any soils within the Turkey Point site consist of marl or muck. The muck consists of herbaceous organic material over limestone. The marl consists of loamy marine deposits over limestone (FPL 2018f, USDA 2017).

3.4.2 Economic Resources

Significant deposits of oil, gas, and other mineable resources are not known to exist beneath the Turkey Point site (NRC 2016a). Large quarries extract limestone rock in south Florida. This mining area is known as the Lake Belt Region. Limestone is found at or near land surface throughout the entire area. It is used as base material for roads and airport runways, as a construction aggregate, and in cement manufacturing (FDOT 2007, NRC 2016a, USGS 2018b, MDC 2017b). From Turkey Point, the nearest limestone quarrying is located 4.5 mi (7.2 km) west of the site (MDC 2017b). Another nearby mining area is the Atlantic Civil rock mine located about 10 mi (16 km) west of Turkey Point (NRC 2016a). Although the near-surface rock at Turkey Point is composed of limestone, the site's location near Biscayne Bay National Park and its saltwater content makes it an unlikely choice for a future limestone mine.

3.4.3 Seismic Setting

Florida has a very small probability of experiencing damaging earthquake effects (FEMA 2018a). Based on historical or statistical seismic activity, Turkey Point is located in an inactive area for earthquakes and far from any recorded damaging shocks (FPL 2018f). Even so, the NRC evaluates the potential effects of seismic activity on a nuclear power plant in an ongoing process that is separate from the license renewal process. The NRC requires every nuclear plant to be designed for site-specific ground motions that are appropriate for its location. Nuclear power plants, including Turkey Point, are designed and built to withstand site-specific ground motion based on their location and the potential for nearby earthquake activity. The seismic design basis is established during the initial siting process, using site-specific seismic hazard assessments. For each nuclear power plant site, applicants estimate a design-basis ground motion based on potential earthquake sources, seismic wave propagations, and site responses, and then account for these factors in the plant's design. In this way, nuclear power plants are designed to safely withstand the potential effects of large earthquakes. Over time, the NRC's understanding of the seismic hazard for a given nuclear power plant may change as methods of assessing seismic hazards evolve and the scientific understanding of earthquake hazards improves (NRC 2014a). As new seismic information becomes available, the NRC expects that licensees will evaluate the new information to determine if safety systems at a plant require changes. Independently, the NRC also evaluates new seismic information and confirms that licensees appropriately consider potential changes in seismic hazards at the site.

SERIES	STRATIGRAPHIC UNIT	LITHOLOGY	TOP DEPTH (ft)	THICK-NESS (ft)	HYDRO-GEOLOGIC UNIT	TOP DEPTH (ft)
HOLOCENE	organic muck	organic soil and silt	0	3	Biscayne Aquifer	0 - 3
PLEISTOCENE	Miami Formation	sandy, oolitic limestone	3	25		
	Key Largo Limestone	well indurated, vuggy, coraline limestone	28	22		
	Ft Thompson Formation	poor/well indurated fossiliferous limestone	50	65		
PLIOCENE	Tamiami Formation	sand and silt with calcarenite limestone	115	105	Intermediate Confining Unit	140
MIOCENE	Hawthorne Group: Peace River Formation	silty calcareous sand and silt	220	235		
	Hawthorne Group: Arcadia Formaion	calcareous wackestone with indurated limestone, sandstone and sand	455	555		
OLIGO-CENE	Suwannee Limestone	fine-grained limestone and dolomitic limestone	1010	245	Upper Floridan Aquifer (USDW)	1010
EOCENE	Avon Park Formation	fine-grained limestone and dolomite	1255	(~445)	Middle Floridan Confining Unit	1450
		permeable limestone	(~1700)	(~75)	APPZ (?)	(1700)
		fine-grained limestone and dolomite	(1775)	745	Middle Floridan Confining Unit	1930
	Oldsmar Formation	limestone, dolomitic limestone and dolomite	2580	450	Lower Floridan Aquifer	2915
		Boulder Zone	3030	>200	Boulder Zone	3030

Source: NRC 2016a

Figure 3-6 Geologic Stratigraphy and Major Aquifers Beneath the Turkey Point Site

3.5 Water Resources

This section describes surface water and groundwater resources at and around the Turkey Point site, with an emphasis on Turkey Point, Units 3 and 4.

At the Turkey Point site, surface water (including the area's freshwater canals, wetlands, and the adjoining Biscayne Bay) and groundwater are closely connected. This close relationship is attributable to the very high permeability of the underlying Biscayne aquifer, which permits water to move relatively freely between the surface and subsurface and vice versa. As a result, the

CCS is hydraulically connected to surface waters including Biscayne Bay via the groundwater pathway. These factors have been considered as part of the NRC staff's characterization of surface water and groundwater resources as presented in Sections 3.5.1 and 3.5.2 below, as well as in the staff's impact analyses for water resources presented in Section 4.5, "Water Resources".

3.5.1 Surface Water

Surface water encompasses all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and man-made reservoirs or impoundments.

3.5.1.1 Surface Water Hydrology

<u>Local and Regional Hydrology</u>

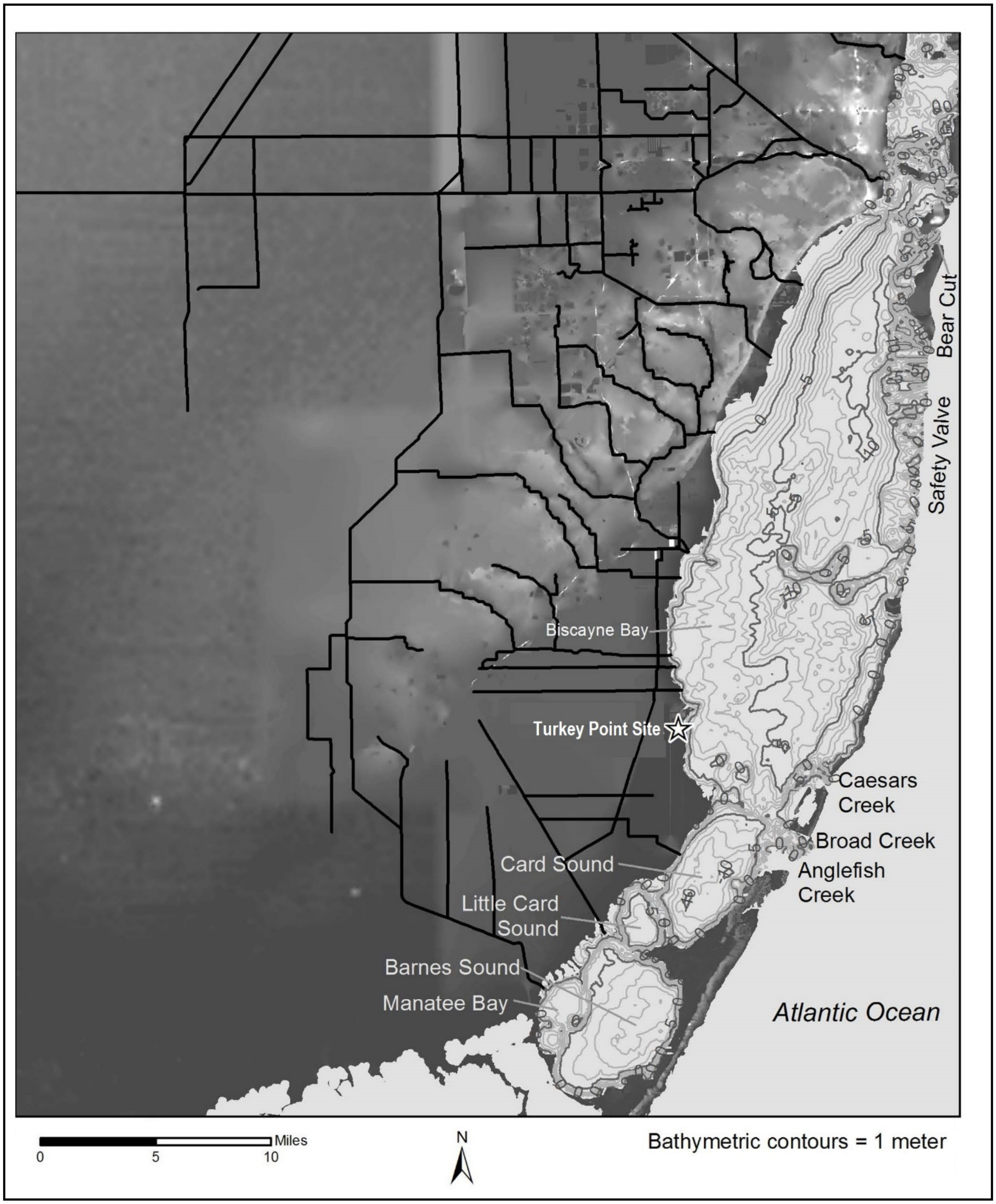
Biscayne Bay and the area around Turkey Point are part of the South Florida Hydrologic System (Figure 3-7). This encompasses a large area that includes the Everglades and South Florida coastal areas. Human activities have extensively influenced this system principally by population increases and land-use changes that resulted in the conversion of wetlands to agriculture and other uses. A significant contributor to these changes was the use of canals to drain land and redistribute surface water to other areas.

The South Florida Hydrologic System and how it has changed over time is described in the EIS for the Turkey Point Units 6 and 7 combined licenses (NRC 2016a) in Section 2.3.1.1 from pages 2-25 to 2-30, including Figures 2-8, 2-9, 2-10, and 2-11. The NRC staff incorporates the above text and figures into this SEIS by reference.

The regional surface water system west of Biscayne Bay encompasses the area east and south of the section of the Atlantic Coastal Ridge (ACR) near Biscayne Bay. Historically, various natural swales or glades and sloughs conveyed freshwater eastward to the coastal wetlands adjacent to Biscayne Bay and Card Sound. From there, freshwater discharged into Biscayne Bay and Card Sound either directly by surface water from the coastal wetlands or indirectly through groundwater. Under current conditions, manmade canals crisscross the landscape. These canals drain the land for agriculture and urban use, provide flood control, and discharge their freshwater into Biscayne Bay and Card Sound (NRC 2016a).

The canals also have an indirect impact on groundwater resources. Draining the land causes the water level in near-surface aquifers to drop. This in turn has contributed to the inland movement of groundwater that contains salt (saltwater intrusion) from Biscayne Bay and Card Sound (see Section 3.5.2). The canals contain control structures to prevent the inland movement of surface water from Biscayne Bay and Card Sound. During the wet season (typically, the months of June – October), coastal control structures periodically open and discharge freshwater to Biscayne Bay. During the dry season, coastal control structures generally remain closed to maintain relatively high water levels along the coast and prevent saltwater intrusion within near-surface aquifers. (USGS 2001).

The Turkey Point Units 6 and 7 COL EIS (NRC 2016a) in Section 2.3.1.1 (on Pages 2-31 and 2-32, including Figure 2-12) describes the regional surface water system west of Biscayne Bay and how it has changed over time. The NRC staff incorporates this text and figure into this SEIS by reference.



Source: Modified from NRC 2016a

Figure 3-7 Turkey Point Site, Biscayne Bay, Card Sound, and Regional Canals

Biscayne Bay and Card Sound

Biscayne Bay is located east of and adjacent to the Turkey Point site. (Figure 3-7). Card Sound is located to the southeast of the site. Both are shallow bays that formed in depressions in the limestone bedrock. The bays are bounded on the east by coral keys that are formed from wave-resistant limestone. Both Biscayne Bay and Card Sound are in direct contact with the Biscayne aquifer as the limestone rock of the aquifer forms the bottom of both bays (see Section 3.5, "Groundwater Resources") (NPS 2015a, NPS 2012, NRC 1972, USGS 2008b).

Biscayne Bay and Card Sound are separated by Cutter Bank which is an underwater topographic rise (mud bank) (NRC 1972). Near the Turkey Point site, both Biscayne Bay and Card Sound are shallow bays. Within Biscayne Bay, over most of the distance between the Turkey Point site and the coral keys, the depth of the water generally ranges from 2 to 6 ft (0.6 to 1.8 m), reaching a maximum depth of about 7 ft (2.1 m). Within Card Sound, over most of the distance between the Turkey Point site and the coral keys, the depth of the water generally ranges from 4 to 9 ft (1.2 to 2.7 m), reaching a maximum depth of about 10 ft (3 m) (NOAA 2018a). Both Biscayne Bay and Card Sound are connected to the Atlantic Ocean by gaps between the coral keys. However, near the Turkey Point site, the enclosed configuration of the coral keys has isolated much of Biscayne Bay and Card Sound from direct marine influence (USGS 2008b).

The hydrology and hydrodynamics of Biscayne Bay and Card Sound are influenced by several factors: (1) tidal exchange of marine waters from the Atlantic Ocean, (2) surface and groundwater inflows of freshwater, (3) precipitation, and (4) evaporation (NRC 2016a). All of these factors also influence the salinity in Biscayne Bay and Card Sound. During the wet season, precipitation decreases the salinity in the bay and the sound. During dry periods, evaporation increases salinity within the bay and the sound, and salinities can become hypersaline (NRC 2016a).

The construction of drainage canals on the mainland has also impacted salinity in the bay and sound. This impact is greatest in the near-shore areas adjacent to the mainland. Prior to the construction of drainage canals, freshwater entered the bay and sound from the mainland by widespread sheet flow and groundwater discharge. This provided a more uniform and continuous supply of freshwater to the bay and the sound than the present situation. With the construction of drainage canals, freshwater was less uniformly distributed as the canals discharged freshwater at discrete locations. The result is that areas near canal discharge locations have less saline water than areas farther away from the discharge locations (NRC 2016a).

Another way that drainage canals have impacted salinity in the bay and the sound is through seasonal differences in the amount of canal discharge. The canals generally discharge the most freshwater into the bay and sound during wet times of the year and the least during dry periods. As a result, salinity concentrations throughout the year in the bay and sound are more variable in time and space than prior to the construction of drainage canals (NRC 2016a).

Around the Turkey Point site, drainage canals discharge to Biscayne Bay north of the site and to Card Sound south of the site. The Turkey Point site occupies an area of former sheet flow that discharged into the bay. However, development of the site's location blocks sheet flow from reaching Biscayne Bay (NRC 2016a).

Pollution from human activities also impacts the water quality of Biscayne Bay. Sections of the shoreline of Biscayne Bay are highly developed. The southern end of Biscayne Bay and Card Sound is less urbanized than the northern section of Biscayne Bay. Pollutants can potentially enter Biscayne Bay from multiple sources, including boats, canals, quarrying operations, landfills, military operations, a sewage-treatment plant, urban and agricultural runoff, and submarine groundwater springs (USGS 2008b).

The EIS for the Turkey Point Units 6 and 7 combined licenses (NRC 2016a) in Section 2.3.1.1 (on pages 2-33 through 2-38, including Figures 2-14, and 2-15, and Table 2-8) describes the hydrology and hydrodynamics of Biscayne Bay. The NRC staff incorporates the above text and figures into this SEIS by reference.

<u>Management of Biscayne Bay and Card Sound Water Quality</u>

The Florida legislature has designated Biscayne Bay and Card Sound, including Biscayne National Park, as Outstanding Florida Waters. This affords these waters the highest water quality protections in the State (NRC 2016a; Robles, et al 2005; NPS 2012). The FDEP cannot issue permits for direct discharges to Outstanding Florida Waters that would lower ambient (existing) water quality and may not issue permits for indirect discharges that would significantly degrade a nearby waterbody designated as an Outstanding Florida Water (FDEP 2017a).

Card Sound and the north half of Biscayne Bay are within the Biscayne Bay Aquatic Preserve. The FDEP’s Office of Coastal and Aquatic Managed Areas manages this preserve (NRC 2016a). One of the management goals is to protect and enhance the waters of the preserve so the public may enjoy the traditional recreational uses of those waters such as swimming, boating, and fishing. No wastes or effluents which substantially inhibit the accomplishment of these purposes can be discharged into the preserve (Florida Statute 258.397).

The rest of Biscayne Bay is within Biscayne National Park (Park), including the Biscayne Bay waters adjacent to the Turkey Point site (NRC 2016a). Biscayne National Park was established “in order to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty” (USGS 2008b). The park is managed by the U.S. National Park Service. In 2015, a Final General Management Plan was completed for the Park. This plan contains strategies on the management of the resources and activities within the Park to best fulfill Biscayne National Park's mission. It can be found under reference NPS 2015a.

<u>Marshland and Mangrove Areas Adjacent to the Turkey Point Site</u>

The Turkey Point site is adjacent to marshland outside its northwest, west, and southern boundaries and a significant portion of its eastern boundary. Surface water within the marshland lies on top of muck, which in turn lies on top of the Biscayne aquifer. The surface water hydrology of the marshlands is driven by rain, surface water runoff, freshwater canal overflows, and saltwater from Biscayne Bay and Card Sound (tides, storms, groundwater) (FPL 2016a). Mangrove areas are located adjacent to Biscayne Bay. Soil pore water samples from the marshland muck show that the marshlands adjacent to and west of the Turkey Point are filled with freshwater, whereas marshlands adjacent to and south and east of the Turkey Point site are filled with brackish water. The marshlands become more brackish the closer they are to Biscayne Bay or Card Sound (FPL 2014b, 2016a, 2017a).

Canals Adjacent to the Turkey Point Site

A network of drainage canals provides freshwater and drainage to southeastern Florida (FPL 2018f). Some of these canals can be found near the Turkey Point site (Figure 3-4). The CCS does not have a surface water connection with any of these canals. North of the Turkey Point site, the Florida City Canal runs east to west and discharges fresh water into Biscayne Bay (FPL 2014a). West of the Turkey Point site, the L-31E Canal contains freshwater and runs northeast to southwest (FPL 2016a).

South of the Turkey Point site, the S-20 Canal and the Sea Dade Canal remnant canal run east to west. The S-20 Canal runs outside the southeast corner of the CCS. It is connected to the L31E Canal by a flow control structure on its western end and connects to Card Sound south of the site. The S-20 Canal contains fresh water when water is being discharged through it and marine water when there is no fresh water discharge through it. The Sea Dade Canal once connected to the S-20 Canal; however, under the provisions of the Everglades Mitigation Bank program, the Sea Dade Canal was plugged off from the S-20 Canal. The Sea Dade Canal is currently a remnant, dead-end canal with no connection to either the Card Sound or Biscayne Bay. The Card Sound remnant canal is also adjacent to the CCS. It runs in a generally north-south direction and dead ends against the outside of the CCS. It contains marine water and connects to Card Sound.

Potential for Flooding at the Turkey Point Site

The NRC evaluates the potential effects of floods on a nuclear power plant in a separate and distinct process, outside of the license renewal process. The NRC addresses flood hazard issues on an ongoing basis at all licensed nuclear facilities (NRC 2013a). The NRC requires every nuclear power plant to be designed for site-specific floods, to assure protection for safety-related equipment and facilities. As new information on flood hazard issues becomes available, the NRC expects each licensee to evaluate the new information to determine if its plant requires changes to protect its safety systems. The NRC also evaluates new information important to flood projections and independently confirms that a licensee's actions appropriately consider potential changes in flooding hazards at the site.

FPL recently completed a flood analysis for Turkey Point Units 3 and 4 and submitted its analysis to the NRC in a process that was separate from subsequent license renewal. After extensive review, the NRC approved this flood analysis on June 29, 2017 (NRC 2017b). FPL's flood analysis used conservative methodology and assumptions, including tidal flooding during hurricanes and future sea level rise during the currently licensed period (ending in July 2032 and April 2033 for Unit 3 and Unit 4, respectively).

Class 1 structures on the Turkey Point site are flood protected up to a minimum elevation of 20 feet (6.1 m) MSL. Components vital to safety, with the exception of the intake cooling water (ICW) pumps, which are protected to 22.5 feet (6.9 m) MSL, are protected against flood tides and waves up to 22 feet (6.7 m) MSL on the east side of Turkey Point (FPL 2018f).

In an emergency, if Turkey Point Units 3 and 4 are unable to obtain cooling water from the CCS, the reactors would be placed in a safe shutdown mode. While in this mode, the reactors would still need to be cooled, but would require much less cooling water. Should this situation ever occur, water for cooling would be supplied from a protected well that obtains brackish water from the Upper Floridan aquifer.

For structures that are important to the safe operation of the nuclear units, the NRC requires that they be designed and operated in consideration of potential flooding. The NRC does not have similar requirements for nonsafety-related. At the Turkey Point site, such structures include, for example, office buildings, the Unit 5 cooling towers, and the CCS.

Tidal flooding during hurricanes is the major flooding concern at the Turkey Point site. The highest tide nearest the site was recorded in September 1965 during Hurricane Betsy and reached an elevation of 10.1 ft (3.1 m) MSL. The station where the measurement was made is located north of Palm Drive on the Florida City Canal, approximately 2.3 mi (3.7 km) west of the shoreline. In 1965, debris marks from the flood tide associated with Hurricane Betsy were seen at an elevation of approximately 10 ft (3 m) MSL at the Turkey Point Site (FPL 2018f).

Because of the low flat terrain, tidal floodwaters in the Turkey Point area can move inland several miles and can cover large areas. Construction of flood control projects in the area have reduced the possibility of tidal floodwaters reaching agricultural and populated areas. The L-31E Canal, which is not part of the Turkey Point site, is designed to provide flood protection to properties further west. This canal is located west of the Turkey Point site and generally runs from southwest to northeast. It includes a levee with a crest elevation of 7 ft (2.1 m) MSL. However, it is not designed to prevent flooding from severe hurricanes with tidal flooding. Based on published storm-tide frequency studies, it is estimated that a 7 ft (2.1 m) tide may occur once every 20 to 25 years near the Turkey Point site (FPL 2018f).

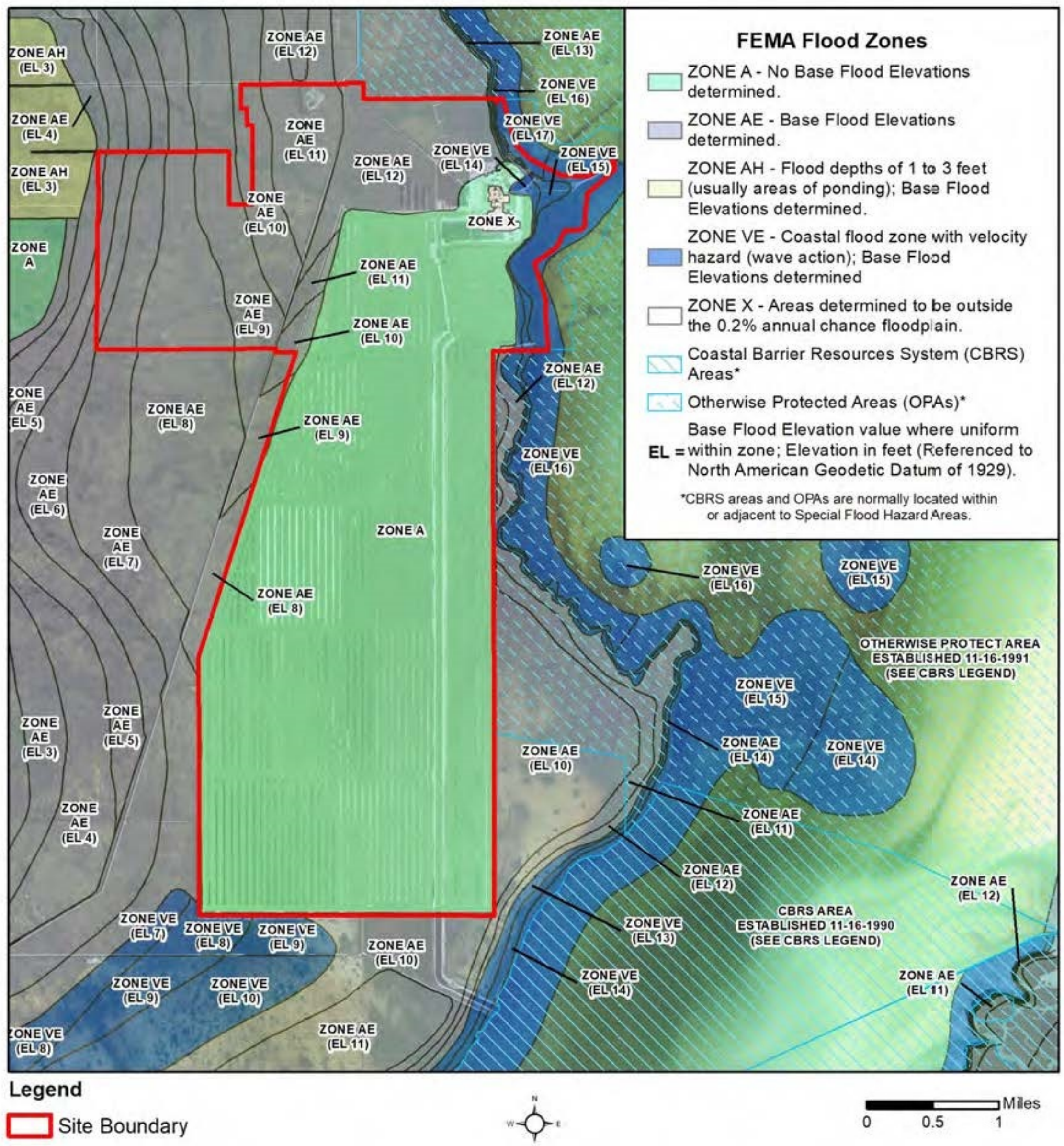
The Federal Emergency Management Agency (FEMA) has prepared flood zone maps that cover the Turkey Point site and surroundings (Figure 3-8). Except for Units 3 and 4, FEMA maps most of the Turkey Point property and the surroundings as Zone A (FPL 2018f). A Zone A area has a 1-percent annual chance of flooding within any single year (FEMA 2014). The water depth of a flood with a 1-percent chance of annual flooding in any single year is called the base flood (FEMA 2018b).

Within the Turkey Point site, FEMA designates a small area near the shoreline along the northeastern property line as within the coastal flood zone with hazardous wave action, and with base flood depths of 14 to 17 feet (4.3 to 5.2 m) (NAVD88). FEMA designates approximately 27 percent of the Turkey Point property as within the coastal flood zone with base flood depths of 11 to 14 ft (3.4 to 4.3 m). However, the remaining 70 percent of the site where the canal system is located has no base flood elevations determined by FEMA. Inland from and just outside and along the western boundary of the CCS, base flood depths range from 8 to 11 ft (2.4 to 3.4 m) (FPL 2018f).

The increased potential for future coastal flooding based on climate change projections is discussed in Section 4.15.3.2 (Climate Change) of this SEIS.

3.5.1.2 Surface Water Consumption

Surface water resources are not consumed by Turkey Point operations. All water consumed by Turkey Point is derived from groundwater resources.



Source: From FPL 2018f

Figure 3-8 FEMA Flood Zones Map of the Turkey Point Property

3.5.1.3 Surface Water Discharges

Operations at Turkey Point do not discharge to surface water bodies outside of the Turkey Point site. All surface water discharges from Turkey Point activities are directed into the CCS, which does not connect to any other surface water bodies.

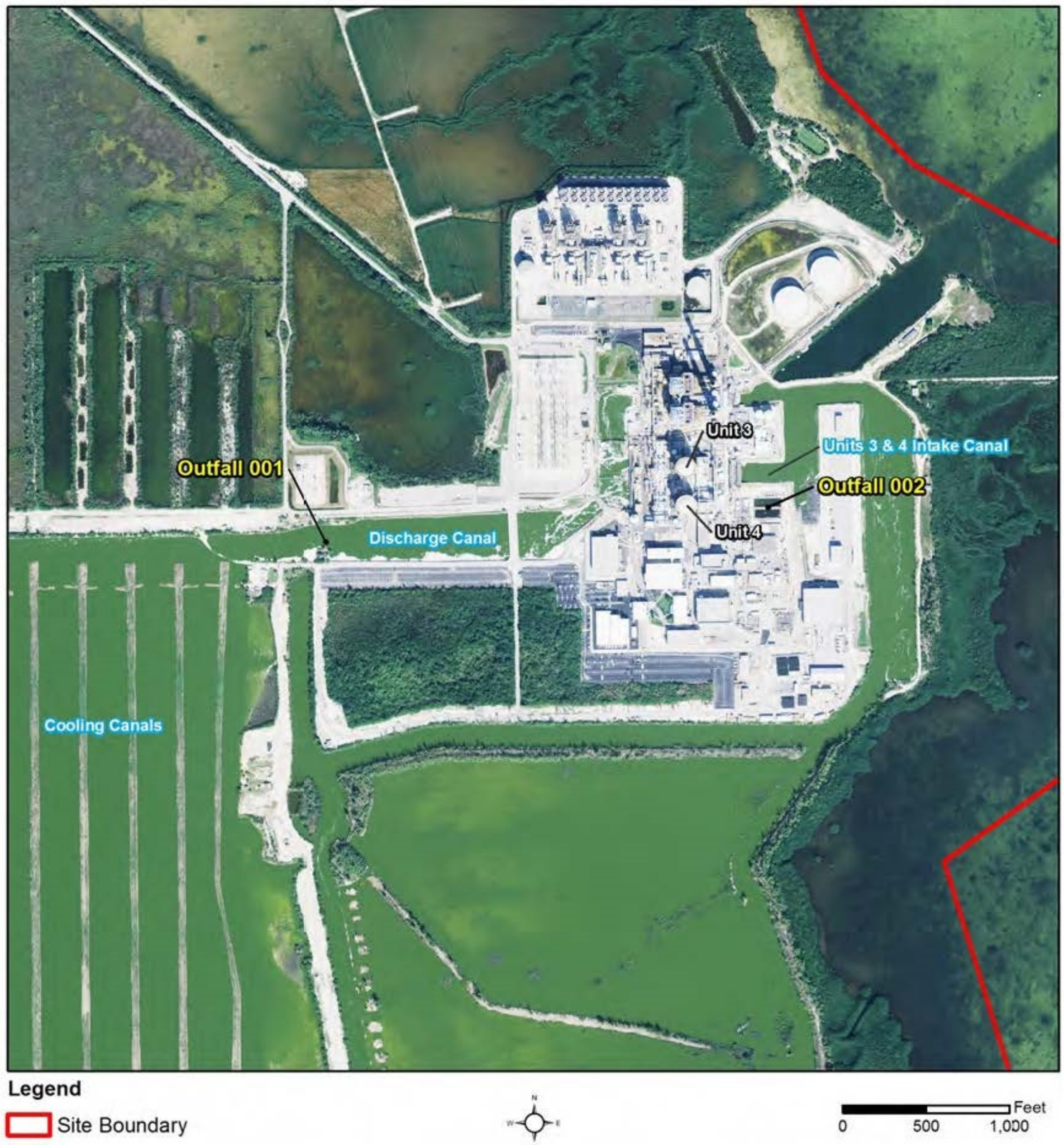
Sanitary wastewater from Turkey Point is routed to an onsite, county- and State-permitted, contact stabilization sewage treatment plant. Effluent from this wastewater treatment plant is discharged to an onsite, permitted, single Class V, Group 3 gravity underground injection well. The well is used to dispose of up to 35,000 gpd (132 m^3/day) of domestic wastewater effluent. It discharges into the top of the Biscayne aquifer and is open from 42 to 62 feet (12.8 to 19 m) below ground surface. Any wastewater residuals are transported to an approved offsite facility. FPL monitors the clarified wastewater sludge to ensure it does not present a risk to the environment or to public health (FPL 2018f). The Florida Department of Environmental Protection manages sanitary waste under FDEP Sewage Treatment Facility Domestic Wastewater Facility Permit No. FLAO13612-002-DW3P and FDEP Sanitary Wastewater Disposal Well Domestic Wastewater Facility Permit No. 0127512-002-UO.

FPL discharges stormwater and all other discharges from Turkey Point Units 3 and 4 and the other facilities at the Turkey Point site to the CCS. Consistent with EPA and State determinations, neither FPL nor the State of Florida considers the CCS to be "waters of the United States" or "waters of the State" (FPL 2018f). FPL operates the CCS as an industrial wastewater (IWW) facility under National Pollutant Discharge Elimination System (NPDES)/IWW Permit No. FL0001562. This permit is issued pursuant to the Federal NPDES program and the Florida Industrial Waste Water permitting program. FPL submitted a permit renewal application to the State of Florida on October 21, 2009. Since that time, the 2005 permit has been administratively continued and remains in effect at this time. The NPDES permit covers all plant discharges including discharges from Turkey Point Units 1, 2, 3, 4, and 5.

The NPDES permit authorizes wastewater discharges, including stormwater, through two internal outfalls into the CCS. Internal Outfall I-001 is located on the southern bank of the discharge canal that leads to the CCS; Internal Outfall I-002 is located in the Units 1 and 2 settling basins (see Figure 3-9). Stormwater from Turkey Point discharges through Internal Outfall I 002 (FPL 2018f). Water quality parameters monitored by FPL under the Turkey Point NPDES permit include copper, iron, lead, pH, salinity, specific conductance, temperature, total suspended solids, zinc, and oil and grease (FPL 2018f).

The permit authorizes discharges to "waters of the State." However, while the permit authorizes discharges to "groundwater of the State" it does not authorize direct discharges to surface waters of the State. The permit authorizes discharges from the CCS into the surficial aquifer, which is the Biscayne aquifer. Beneath the CCS, the groundwater in the Biscayne aquifer is classified as Class G-III groundwater (FDEP 2005, FPL 2018f). As a result of its high total dissolved solids content, Class G-III groundwater is not considered to have a reasonable potential as a future source of drinking water (FPL 2018f, FAC 62-520.410, UF 2018a).

While the State of Florida regulates nonradioactive liquid releases from Turkey Point, the NRC regulates radioactive releases from Turkey Point. Liquid releases of radionuclides within NRC allowable limits are a part of normal nuclear power plant operations. Liquid releases from Turkey Point operations are discharged into the CCS via Internal Outfall I-001 (FPL 2018f). The NRC monitors the amount and types of radionuclides and the calculated dose to the public to confirm that releases are below NRC thresholds as defined in NRC regulations.



Source: From FPL 2018f

Figure 3-9 Florida Department of Environmental Protection NPDES Permitted Outfalls

<u>CWA Section 401 Certification</u>

Section 401 of the Clean Water Act (33 U.S.C. 1251 et seq.) requires an applicant for a Federal license to conduct activities that may cause a discharge of regulated pollutants into navigable waters to provide the licensing agency with a water quality certification from the State. This Section 401 certification implies that discharges from the project or facility to be licensed will comply with Clean Water Act requirements and will not cause or contribute to a violation of State water quality standards. If the applicant has not received a Section 401 certification, the

NRC cannot issue a license unless that State has waived the requirement. The NRC recognizes that some NPDES-delegated States explicitly integrate their Section 401 certification process with NPDES permit issuance (NRC 2013a).

The Power Plant Siting Act (PPSA) certification from the State of Florida is a non-expiring permit that remains valid for the life of the facility. Under the PPSA, FPL is not required to obtain a new certification for NRC subsequent license renewal. The certification will remain effective, as will any legal effects of the certification, including the certification's compliance with State water quality standards for the life of the facility. Therefore, there is no requirement for FPL to obtain a new determination of compliance with State water quality standard for Turkey Point Units 3 and 4 subsequent license renewal (FPL 2018f, FPL 2018g).

3.5.1.4 Adjacent Surface Water Quality and Cooling Canal System Operation

Within the Turkey Point site, the cooling canal system is the largest body of water. This section of the SEIS describes recent studies to evaluate potential effects of CCS operations via the movement of groundwater from the CCS to adjacent surface water bodies.

In response to orders from the State of Florida and Miami-Dade County, FPL conducts an extensive water quality monitoring program that includes the CCS, Biscayne Bay, Card Sound, marshland, mangrove areas, and canals adjacent to the CCS. A major objective of this program is to evaluate the effects, if any, of CCS operation on the surrounding environment. The monitoring program and some of its data and findings are contained in a number of documents (FPL 2010, FPL 2011a, FPL 2014b, FPL 2016a, FPL 2016e, FPL 2016f, FPL 2016g, FPL 2017a, and FPL 2017b) (See Figure 3-10).

This water quality monitoring program monitors surface water bodies for numerous water quality parameters, including ammonia and other nutrients and salinity. Water temperature in the CCS is also monitored, but FPL has not detected CCS waters affecting temperatures in adjacent water bodies.

FDEP Administrative Order DEP #16-0111, uses tritium, in conjunction with saline water, as a tracer to estimate the spatial extent of waters originating from the CCS (FDEP 2016h). At levels in accordance with NRC allowable limits, Turkey Point Units 3 and 4 discharge liquid water containing tritium into the CCS in batch releases. Units 3 and 4 also release tritium as a gaseous emission (steam water or vapor water) into the air.

Tritium is a hydrogen atom with an atomic mass of three instead of one (NRC 2006a); like any other hydrogen atom, it usually binds with oxygen to form a water molecule. A water molecule that contains hydrogen in the form of tritium will behave in the environment just like a water molecule that does not contain tritium. There are two possible pathways for tritium to leave the CCS and move to another surface water body: (1) through the groundwater pathway within liquid water or (2) through air within gaseous water (steam or vapor water). Therefore, for surface water samples collected in bodies of water near the CCS, these two possible pathways are considered when interpreting the data.

Tritium emits a weak form of radiation in the form of a low-energy beta particle similar to an electron. This radiation does not travel very far in air and cannot penetrate the skin. If tritium enters the body, it disperses quickly and is uniformly distributed throughout the soft tissues. Tritium has a half-life of 12.3 years. This means that after 12.3 years, half of the tritium will be gone through decay into a form that is no longer radioactive. However, if ingested, the human body excretes half of the tritium ingested within approximately 10 days (NRC 2006a). For tritium in drinking water, EPA has established a maximum contaminant level of 20,000 pCi/L (EPA 2002, NRC 2006b).

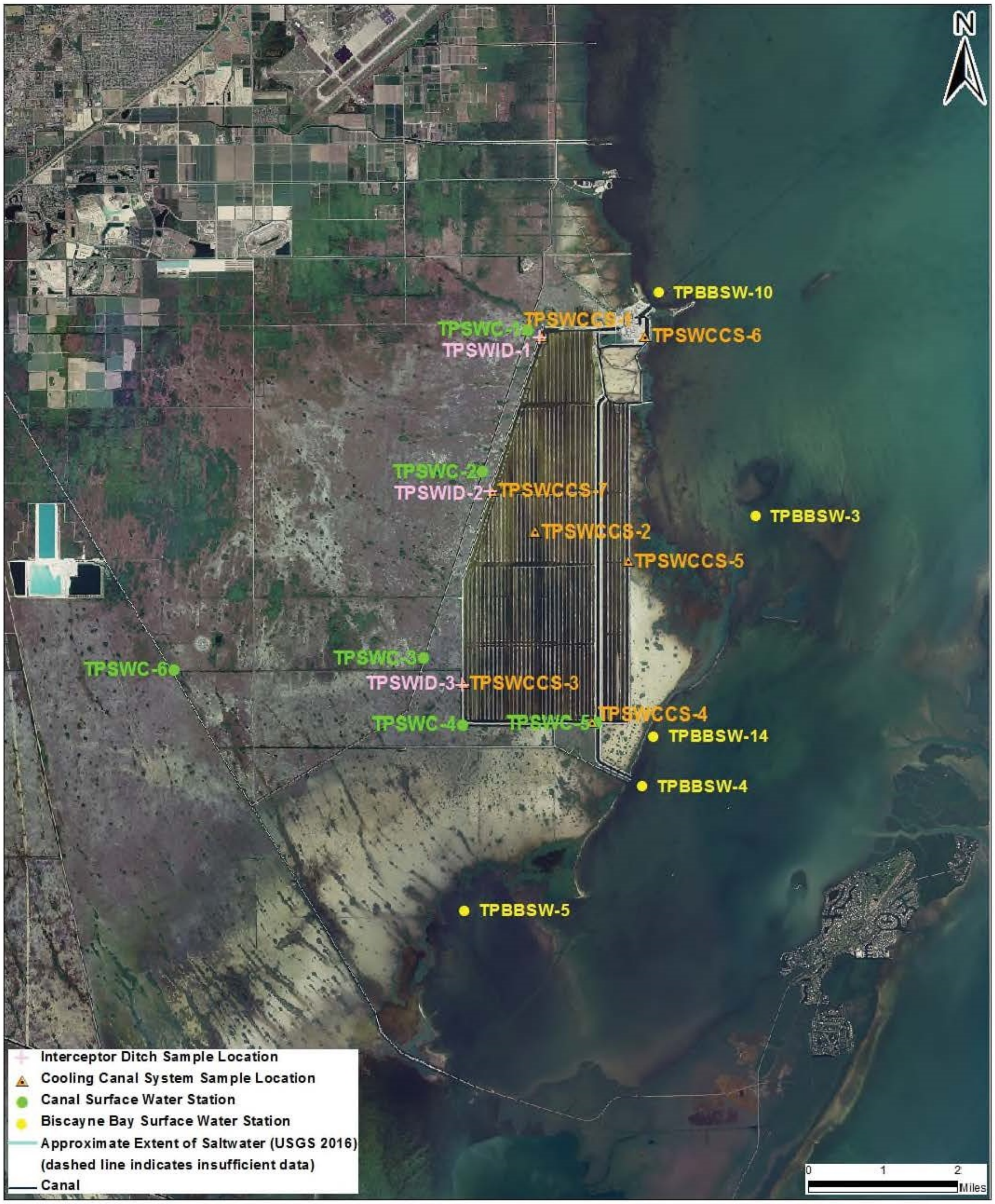
At the levels that have been measured within the CCS, tritium is not a public health concern. With the exception of rare outliers, measurements of tritium concentrations at sampling locations within the CCS have been below the EPA maximum contaminant level of 20,000 pCi/L for tritium in drinking water. Although tritium levels in some areas may somewhat exceed the EPA's maximum contaminant level of 20,000 pCi/L for tritium in drinking water, salt concentrations make the water in the CCS non-potable, and there are no drinking water wells on or near the site. Also, while tritium has been detected in adjacent water bodies, the concentrations were very low and often extremely low relative to the EPA's maximum contaminant level of 20,000 pCi/L for tritium in drinking water (FPL 2010, FPL 2011a, FPL 2014b, FPL 2016a, FPL 2016e, FPL 2016f, FPL 2016g, FPL 2017a, and FPL 2017b).

<u>Water Quality within the Cooling Canal System</u>

The following text describes ammonia and nutrients and salinity conditions within the CCS. As CCS water temperatures also have an effect on CCS water salinities, the following text also includes a discussion of water temperature in the CCS. Any mitigating actions within the CCS to reduce any indirect effects on groundwater, ecology, and on adjacent surface water bodies are also described.

<u>*Ammonia and Nutrients within the Cooling Canal System*</u>

Ammonia is released into the waters of the CCS by the decay of organic material within the CCS. Between June 2010 and May 2016, ammonia concentrations within the CCS ranged from below detectable levels to 0.3 mg/L and averaged 0.04 mg/L (FPL 2017c). The Miami-Dade County water quality standard for ammonia is 0.5 mg/L (FPL 2018m). The Turkey Point CCS values are all below this standard.



Source: From FPL 2017a

Figure 3-10 Locations of Surface Water Monitoring Stations

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

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

Prior to 2010, the CCS operated as a seagrass-based biological system. Seagrass grew beneath the water on the bottom of the channels, covering an estimated 50 percent of the channel bottoms. The seagrass provided habitat for aquatic life, provided natural filtration of suspended material, and removed nutrients from the water within the CCS. This ecosystem helped to maintain good water quality and low nutrient concentrations in the CCS waters (FPL 2018f).

By 2010, this ecosystem had begun to change dramatically. CCS salinities had increased to the point that the seagrass meadows were dying. By 2012, few seagrass beds remained. The decomposition of the dead seagrass released a significant volume of nutrients into the waters of the CCS. This increase in nutrients facilitated seasonal algae blooms, resulting in high turbidity and generally degraded water quality within the CCS (FPL 2018f).

Nutrient Management Plan for the Cooling Canal System

In accordance with a June 20, 2016 consent order between FPL and the State of Florida (FDEP 2016a), FPL submitted to the FDEP a nutrient management plan for the CCS. This management plan is composed of three primary nutrient management strategies: (1) active algae and 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 this nutrient management plan, FPL has performed bench and pilot tests to find the most appropriate active nutrient and algae removal methods for the unique ecology and water chemistry of the CCS. These nutrient and algae removal methods include using chemical flocculants/coagulants, nonchemical means (i.e., physical removal), and aeration. In addition, FPL reviewed Turkey Point canal practices in order to revise them to integrate the goal of minimizing erosion and nutrient inputs from sediment and berm sources (FPL 2017b).

Temperatures within the Cooling Canal System

The temperature of the CCS varies in response to factors such as heated water discharged by Units 3 and 4 into the CCS, air temperature, wind, precipitation, Biscayne aquifer groundwater flowing into and out of the CCS, and water that FPL adds to the CCS from wells to reduce salinity. To a lesser extent, discharges of water into the CCS from the interceptor ditch and the Turkey Point Unit 5 cooling tower blowdown can also impact the temperature of water within the CCS.

Historically, Turkey Points Units 1, 2, 3, and 4 all contributed heat to the CCS. Units 1 and 2 are now retired and no longer contribute heat to the CCS. Even under current operations (i.e., after the NRC approved power uprates for Units 3 and 4 on June 15, 2012 (NRC 2012)), the heat that Units 3 and 4 discharge to the CCS is less than the amount of heat Turkey Point had discharged to the CCS when Units 1, 2, 3, and 4 were all in operation.

Due to the discharge of heat into the CCS, water temperatures in the CCS are higher than ambient air temperatures (FPL 2018f). 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 from the discharge area, through the canals, and then towards the intake area, the water temperature drops (FPL 2016a). As expected, the highest water temperatures in the CCS are found where Units 3 and 4 discharge hot water into the CCS (Station TPSWCCS-1); the lowest water temperatures are found at the cooling water intake for Units 3 and 4. From June 2010 through May 2017, average monthly temperature values collected at all seven monitoring stations within the CCS ranged from 52.7 °F (11.5 °C) to 115 °F (46.3 °C), and produced an average monthly temperature of 88 °F (30.4 °C) (FPL 2017a).

The CCS serves as the ultimate heat sink to cool Units 3 and 4. On August 8, 2014, the NRC established an ultimate heat sink temperature limit for the cooling canals of 104 °F (40 °C) (FPL 2018f, NRC 2014d, 79 FR 44464, 80 FR 76324). To judge compliance with this limit, FPL measures water temperature from a sampling location in 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 at this sampling location (station TWSWCCS-6) have not exceeded the NRC's ultimate heat sink limit of 104 °F (40 °C) (FPL 2017a).

Prior to August 2014, the NRC had set the ultimate heat sink limit at the slightly lower temperature of 100 °F (37.8 °C). In early July 2014, the water temperature in the cooling canals began to approach the limit of 100 °F (37.8 °C). FPL then requested an increase in the temperature limit; in response, the NRC performed a safety and environmental analysis, and then established the current heat sink temperature limit of 104 °F (40 °C) (NRC 2014b).

FPL believes that the 2014 increase in average CCS temperatures was necessitated by:

- low average precipitation into the CCS from 2011 through 2014
- poor water circulation through the CCS due to blockages and sediment accumulation
- reduced heat exchange efficiency caused by factors such as higher salinity, turbidity, and algal concentrations that reduced evaporation rates (FPL 2018f)

Since 2014, FPL has worked to reduce algae concentrations, improve canal circulation, and increase the inflow of groundwater from the Biscayne aquifer into the CCS by sediment removal from CCS channels. For a short period of time, to help lower CCS temperatures, freshwater from Canal L-31E, brackish water from the Upper Floridan aquifer, and saltwater from the Biscayne aquifer was added to the CCS.

According to its environmental report for subsequent license renewal, FPL's current plans to lower CCS temperatures do not include the use of freshwater from State canals (FPL 2018f). In the future, should FPL need to use freshwater from State canals, FPL would need to seek permission to do so from State and county governments. FPL states that future plans to reduce CCS temperatures include adding brackish water from the Upper Floridan aquifer, reducing algae in the CCS, continuing to remove sediment within the CCS, and, only in extraordinary circumstances, pumping saltwater from the Biscayne aquifer into the CCS (FPL 2018f).

Thermal Efficiency Plan for the Cooling Canal System

In accordance with the June 20, 2016 consent order between FPL and the State of Florida, FPL submitted a thermal efficiency plan for the CCS to the FDEP (FDEP 2016a). FPL has identified the maintenance of high thermal efficiency within the CCS as necessary for controlling evaporation and salinity in the CCS. The plan identified primary and secondary performance metrics. FPL will use these metrics to guide its actions to maintain high thermal efficiencies (i.e., thermal efficiency at equal to or greater than 70 percent). On July 7, 2017, the FDEP instructed FPL to implement this thermal efficiency plan (FPL 2017b).

Since July 2017, FPL has implemented several near-term actions under this thermal efficiency plan, including (1) sediment removal in many of the CCS canals, (2) flow management within the CCS, (3) water stage management, and (4) vegetation management. As a result, thermal efficiency in the CCS during the 2017 reporting period met the objectives of the plan, which is to maintain high thermal efficiencies at equal to or greater than 70 percent. For the period between October 2016 through September 2017, FPL reported an annual CCS thermal efficiency of approximately 84 percent (FPL 2017b).

Salinity within the Cooling Canal System

Water in the CCS contains significant concentrations of salt. CCS water is saltier than seawater (i.e., it is hypersaline). The salinities of seawater are around 34–35 practical salinity units (PSU), while the salinity of water in the CCS is presently around 60 PSU, or almost twice the salinity of seawater (EB 2018, FPL 2018f). Salinities in the CCS increase when water leaves the CCS and decrease when less saline water enters the CCS. The highest salinities in the CCS are likely to occur during times of low precipitation and when evaporation rates are high. Conversely, the lowest salinities within the CCS are likely to occur during times of high precipitation and when evaporation rates are low (FPL 2012a). Salinity concentrations are usually at minimum values during the wet season, with the highest salinities at the end of the dry season (FPL 2018f).

Most of the salt in the CCS comes from the groundwater of the Biscayne aquifer which is saltwater. 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, and is hydrologically connected to both the Biscayne Bay and the CCS (FPL 2018f, Tetra Tech 2014, FPL 2016a).

Salt is removed from the CCS when water containing salt moves from the CCS into the Biscayne aquifer. Water that moves from the CCS into the groundwater is likely to reflect the hypersaline conditions of the CCS (around 60 PSU). With its higher salt concentrations, this CCS water is denser than the groundwater of the Biscayne aquifer (FPL 2018f).

As previously stated, in recent years, salinity concentrations within the CCS have been about 60 PSU, or about twice the average concentration of seawater, which is approximately 34 to 35 PSU (FPL 2018a). However, when FPL first constructed the cooling canals in the 1970s, the salinity of the CCS water and the surrounding Biscayne aquifer were about equal to the salinity of saltwater and the adjacent Biscayne Bay (approximately 34 PSU) (FPL 2018f).

As previously described, CCS salinities have varied over time; usually at minimum values during the wet season, with the highest salinities at the end of the dry season. During dry years (periods of drought) the overall salinities at the end of the year were higher than the salinities at the end of the previous year. In this way, drought years produced a ratcheting effect that caused the next year to begin the seasonal cycle of salinity concentrations at higher salinities than the previous year. As a result, average salinities in the CCS gradually increased from approximately 34 PSU in the early 1970s to approximately 90 PSU in 2014 and 2015 (FPL 2017a, FPL 2017b, FPL 2018f).

As CCS salinities increased, the seagrasses in the CCS died off. As the seagrasses died off, not only could they no longer remove nutrients from the water, their decomposition also released considerable amounts of nutrients into the water. The increased nutrient concentrations facilitated the growth of seasonal algae blooms (FPL 2018f). As previously mentioned, from 2011 through 2014, in combination with low average precipitation and poor water circulation through the CCS, the algae blooms contributed to increased temperatures and salinities within the CCS (NRC 2016a).

To help reduce the water temperatures within the CCS, on June 27, 2014, the State of Florida granted FPL permission to add saltwater from the Biscayne aquifer and brackish water from the Upper Floridan aquifer to the CCS (NRC 2016a). In August 28, 2014, the South Florida Water Management District granted FPL permission to add freshwater from the L-31E Canal to the CCS to reduce salinity. After these additions, rainfall also added freshwater to the CCS. CCS salinities and temperatures subsequently returned to pre-summer 2014 levels (around 60 PSU) (FPL 2018f, NRC 2016a).

Salinity Management Plan

In December 2014, the FDEP issued an Administrative Order requiring FPL to submit a salinity management plan to describe how FPL would reduce and maintain the average annual salinity in the CCS at or below 34 PSU (FDEP 2014, NRC 2016a). On October 7, 2015, Miami Dade County and FPL signed a consent agreement (MDC 2015a). In this agreement, it was 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, it was acknowledged that FPL would continue to use water from the L-31E canal to lower CCS salinities until a transition was made to long-term sources of water for the CCS (i.e., brackish water from the Upper Floridan aquifer) (MDC 2015a).

On June 20, 2016, a consent order (FDEP 2016a) was executed by FPL and the FDEP. The consent order requires FPL to maintain the average annual salinity of the CCS at or below 34 PSU. Further, it states that, "[i]f 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, it is anticipated that Upper Floridan aquifer wells will be the water source utilized for salinity reduction (FPL 2018f). As detailed in Section 3.5.2.2.3, 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 being used to help 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 further help to reduce CCS salinities (FPL 2018f).

Study of Water Alternatives to Reduce CCS Salinities

In the October 7, 2015, consent agreement between Miami-Dade County and FPL, it was acknowledged that FPL would consider the practicality and appropriateness of using reclaimed wastewater from the Miami-Dade County South District Waste Water Treatment Plant as an alternative water resource to reduce CCS salinities. To respond to this request, FPL contracted with Golder and Associates to evaluate alternative sources of water. Along with other alternatives, the evaluation considered the practicality and appropriateness of using reclaimed wastewater from the Miami-Dade County South District Waste Water Treatment Plant (SDWWTP) (Golder 2016).

The study considered the following eight alternatives:

1) Excess surface water from the L-31E Canal
2) Biscayne aquifer water from the Inland Biscayne Aquifer Wellfield
3) Reclaimed water from SDWWTP with nutrient removal
4) Reclaimed water from SDWWTP with nutrient removal and advanced treatment for other constituents of concern
5) Upper Floridan aquifer water using artesian wells flowing into the CCS
6) Direct Treatment of CCS water to remove salinity
7) Marine groundwater from wells on the Turkey Point Peninsula with additional fresh water from another source
8) Marine surface water from Biscayne Bay or Card Sound with additional fresh water from another source

The study considered technical, environmental, economic, and social criteria. Relative to the ranking criteria, it ranked Alternative Five as the best overall and the most balanced alternative. It also identified that Alternatives One and Seven should be maintained as short-term backup water options to be used when appropriate and as needed during extreme conditions. It further determined that Alternatives Two, Four, Six, and Eight did not provide a significant advantage and should not be evaluated further unless conditions change. While the study determined that Alternative Three has a high cost and very long implementation schedules; it concluded that this alternative should be further evaluated as a potential long-term solution to a regional problem (Golder 2016).

The alternatives study was reviewed by Miami-Dade County. On December 22, 2016, the County decided that the use of reclaimed water with nutrient removal and advanced treatment, described as (Alternative 4) in the referenced document, could provide a long-term, sustainable source of water to offset CCS water deficits. The County recommended that FPL revisit this alternative for further evaluation as a potential long-term solution (MDC 2016a). The current status of this proposal is unclear.

Application of Numerical Modeling to CCS Salinity Mitigation

The operation of the CCS has been numerically modeled to understand and predict different aspects of the CCS (Chin 2016; Golder 2008; Tetra Tech 2014a; FPL 2012a, FPL 2014b, FPL 2016a, FPL 2016g, FPL 2017a). The most recent modeling was conducted by Tetra Tech for FPL. The focus of this modeling was to quantify the volumes of water and the mass of salt entering and exiting the CCS (FPL 2012a). Model calculations for the various components of the CCS incorporate hydrological, chemical, and meteorological data collected in and around the CCS (FPL 2012a). Selected model inputs were adjusted to calibrate the model against observed changes in CCS water and salt storage. The calibration minimized differences between simulated and observed salt and water storage changes within the CCS. The calibration process builds confidence that the model will produce adequate predictions of CCS behavior (FPL 2014b).

This tool is being used by FPL to understand the effectiveness of its mitigation measures. The most recently published modeling results simulate the operation of the CCS from June 2015 through May 2017. The modelers concluded that over this time period, the addition of Upper Floridan aquifer water helped to moderate dry season salinity without significantly increasing water levels in the CCS (FPL 2017a).

In 2014, Tetra Tech used numerical models to estimate the volume of Upper Floridan aquifer water that would be required to reduce CCS water salinity to seawater range. The modeling exercise produced an estimate that with the addition of 14 mgd (53,000 m^3/day) of Upper Floridan aquifer water that had a salinity of 2 PSU it would require less than a year to reduce salinities in the CCS to 35 PSU (Tetra Tech 2014a). However, while FPL then added an average of 12.8 mgd (48,500 m^3/day) of Upper Floridan aquifer brackish water to the CCS from the beginning of November 2016 to the end of May 2017, salinities in the CCS did not go down to 35 PSU (FPL 2017a). Rather, at the end of May 2017, average salinity concentrations in the CCS were 64.9 PSU (FPL 2017b).

Comparing CCS data and model results, the modelers concluded that during this period (most of which occurred during the dry season), evaporation rates exceeded precipitation rates. Without the addition of brackish water from the Upper Floridan aquifer, the net evaporation vs. precipitation rate would have caused the salinity in the CCS to increase more than was observed. However, the addition of Upper Floridan aquifer water helped to moderate the effects of the dry season (typically, November - April) on the CCS. For example, CCS salinities during the dry seasons of 2014 and 2015, which were not as dry as 2017, exceeded 90 PSU, while the addition of brackish water from the Upper Floridan aquifer and saltwater from the marine wells was effective in keeping CCS salinities below 70 PSU in the 2017 dry season. The modelers anticipate that under more favorable climatic conditions (e.g., less severe dry seasons), the addition of Upper Floridan aquifer water should help to reduce CCS water salinities to 34 PSU (FPL 2017a, FPL 2017b).

As previously stated, in compliance with the June 20, 2016, consent order executed by FPL and the FDEP, if FPL fails to reach an annual average salinity of at or below 34 PSU by the required time periods, FPL is required to submit a plan to the FDEP detailing additional measures, and a timeframe, that FPL will implement to achieve the threshold (see Salinity Management Plan) (FDEP 2016a). Thus, continued actions by FPL and regulatory oversight by the FDEP provide assurance that the CCS should reach the required PSU levels within or close to the designated period.

Ammonia and Nutrients within Biscayne Bay and Card Sound

If the concentration of nutrients in either Biscayne Bay or Card Sound get too high, they can negatively impact the aquatic ecology. Excess nutrients can cause algae blooms (thick green algae mats that can be toxic), deplete oxygen in the water, and reduce water clarity. The State of Florida (with the approval of the EPA) has established numeric nutrient criteria for Biscayne Bay and Card Sound. These water quality standards help to protect the quality of the surface water in the bay and the sound, consistent with the requirements of the Clean Water Act (EPA 2014c). The numeric nutrient criteria include criteria for phosphorus, chlorophyll, and total nitrogen, of which ammonia is a contributor (FDEP 2018e).

Biscayne Bay waters are generally low in plant nutrients. This means the aquatic ecosystems respond very rapidly to small nutrient enrichment, especially to increases of phosphorous. The concentrations of ammonia from runoff tends to be higher in urban runoff than in wetland or agricultural runoff. The Biscayne Bay watershed has a diverse agricultural, urban, and wetland land use. This results in lateral differences in bay water nutrient concentrations (NPS 2011).

In general, ammonia concentrations are higher in the northern portion of Biscayne Bay, which is most urbanized, while the lowest values are next to the Turkey Point site in Biscayne Bay and in Card Sound. Seasonal ammonia values in the bay are lowest late in the dry season, with higher concentrations and increased variability during the wet season (peaking in September or October) (NPS 2011).

Sampling data by Miami-Dade County and FPL in the late fall and winter months of 2015–2016 revealed levels of ammonia concentration that exceeded the County's water quality standard for ammonia (0.5 mg/L) at two surface water quality monitoring stations near the CCS in Biscayne Bay (MDC 2016a). The exceedances for ammonia were detected in the Barge Turning Basin and the remnant canal at Turtle Point (TPBBSW-7 and TPBBSW-8). Both areas are connected to Biscayne Bay. When it was constructed, the Barge Turning Basin was excavated to a depth of approximately 30 ft (9.1 m) and the Turtle Point remnant canal was excavated to a depth of approximately 20 ft (6.1 m). In Biscayne Bay nearby areas have a depth to the bottom of about 1 to 2 ft (0.3 to 0.6 m) (FPL 2018g) (Figure 3-4).

The ammonia exceedances were detected in samples obtained from the bottom of these excavations and close to the CCS. The low dissolved oxygen, hypersalinity, and tritium concentrations found at these locations are consistent with the interpretation that, close to the CCS, the water quality at the bottom of these excavations may be influenced by groundwater that has been in contact with CCS waters. However, the ammonia concentrations in the bottom samples were consistently higher than ammonia levels in the CCS (FPL 2016g). This implies that if groundwater from the CCS was moving into these excavations, some of the ammonia in the Turtle Point remnant canal and the Barge Turning Basin was coming from other sources.

The ammonia exceedances led to the modification of a consent agreement between the County and FPL in 2016. The modified consent agreement requires FPL to prepare and implement a corrective action plan to address ammonia exceedances in surface water surrounding the facility including, but not limited to, waters tidally connected to Biscayne Bay (MDC 2016b, FPL 2016h).

On April 25, 2016, the FDEP issued a warning letter to FPL concerning the sampling data by Miami-Dade County and FPL in the late fall and winter months of 2015–2016 which showed levels of ammonia concentration were exceeding the water quality standard for ammonia

(0.5 mg/L). The letter requested that FPL provide facts to assist in determining whether any violations of Florida law had occurred (FDEP 2016i).

In response to the modified consent agreement between FPL and Miami Dade County, FPL submitted a corrective action plan to Miami-Dade County on September 14, 2016. The plan described a program to identify the source of the ammonia and to define its vertical and horizontal extent within nearby surface waters. Under the plan, an extensive sampling and analysis program was then conducted by FPL that included numerous surface water, pore water, canal, and groundwater sampling locations, as well as stratified surface water sampling and temporal sampling based on tidal cycles. The assessment results were evaluated in detail to determine the nature and extent of ammonia at Card Sound, Turkey Point, and in remnant dead-end canals and the Barge Turning Basin. In addition, an evaluation of water quality within the CCS was performed (FPL 2016h, FPL 2017c).

The study and its conclusions are contained in an assessment published on March 17, 2017 (FPL 2017c). The report concluded that the elevated ammonia values are attributable to the degradation of plant and animal material under anoxic (low oxygen) conditions in areas with little or no mixing with other surface waters. The occurrence of ammonia appears to be limited to the locations of deep stagnant anoxic water bodies. Some of the deep canal sites and many of the groundwater and pore water sites were anoxic and the majority of nitrogen was in the form of ammonia. The studied areas are similar to many locations in coastal Southeast Florida. Regional studies of background surface water quality data for Biscayne Bay indicate that ammonia can be detected at many locations that are not associated with the CCS, at levels greater than 0.5 mg/L (FPL 2017c).

The 2017 report further concluded that the elevated ammonia values were not the result of contamination attributable solely to the Turkey Point site but were the result of natural microbial processes in anoxic, stagnant surface and groundwater environments (FPL 2017c). Ammonia concentrations in the CCS were found to be very low, and the report therefore concluded that the CCS was not the direct cause of the elevated ammonia concentrations in the Turtle Point remnant canal and the Barge Turning Basin. Only surface water samples collected from the bottom of the dead-end canals exceeded the Miami-Dade County standard for ammonia. Outside of these areas, no exceedance of the standard was detected in any other samples within Biscayne Bay near the CCS or in the CCS (FPL 2017c).

The 2017 report also concluded that the ammonia values are consistent with the anoxic conditions that exist at the bottom of remnant canals and the accumulation of organic matter falling into the remnant canals from surrounding areas of the bay. Based on the information obtained, additional work and a corrective action plan were not recommended (FPL 2017c).

On May 16, 2016, FPL submitted to the FDEP the nutrient monitoring results from certain surface water monitoring stations in deep channels adjacent to the CCS for total nitrogen, total phosphorous, and total Kjeldahl nitrogen. The FDEP reviewed this information and determined that no exceedances of surface water quality standards were detected in Biscayne Bay monitoring (FPL 2016a). However, to minimize the potential for future exceedances, the FDEP ordered FPL to implement restoration projects at the Barge Turning Basin and within the remnant canal at Turtle Point (FDEP 2016a). As of July 5, 2018, FPL was in the process of obtaining the final permits for these restoration projects (FPL 2018f).

Restoration activities at the Barge Turning Basin will backfill the Barge Turning Basin up to a depth of 15 ft (4.6 m) below MSL. Restoration activities at Turtle Point will backfill one-third of the remnant canal up to a depth of 0.33 ft (0.1 m) below MSL (for future Mangrove Planting). The rest of the remnant canal will be backfilled with a sloping fill to a final depth of 7 ft (2.1 m) below MSL (FPL 2017c). The backfilled shallow portion will be stabilized with mangrove plantings (FPL 2018d, FPL 2018g). This will reduce the accumulation of organic matter in these deep areas and reduce or eliminate the movement of groundwater from the CCS into these deep excavations connected to Biscayne Bay. Both restoration projects are to be completed within the two-year timeframe required by the FDEP Consent Order (FPL 2018g).

Staff from Miami-Dade County reviewed the 2017 report on ammonia in surface waters and on July 7, 2017, requested that FPL submit more information (MDC 2017d). On July 10, 2018, the Miami-Dade County Division of Environmental Resource Management (DERM) issued a letter finding that total ammonia concentrations at the Barge basin and the Turtle Point remnant canal exceeded the applicable Miami-Dade County surface water standard (MDC 2018a). The DERM acknowledged that the observed elevated surface water ammonia concentrations may be attributable to several contributing sources, including factors not directly related to the operation of the CCS; however, based on an evaluation of tritium concentrations and temperature data, DERM found that the CCS is a contributing source to the ammonia concentrations in those areas.

The DERM letter required FPL to submit a plan to address CCS nutrient impacts to groundwater and surface water resources beyond the boundaries of the CCS. In the letter, DERM acknowledged that management of water quality within the CCS may be effective in reducing water quality impacts observed beyond the CCS facility boundaries. DERM also required FPL to implement the proposed plan to fill the barge basin and the Turtle Point remnant canal (MDC 2018a).

Salinity within Biscayne Bay and Card Sound

The salinity of the water in Biscayne Bay and Card Sound affects their ecosystems. Sustained lower-than-seawater salinities are required to maintain the ecology of freshwater wetland, tidal wetlands and mainland nearshore areas, to provide nursery habitat for fish and shellfish (Audubon 2016, NPS 2012). As previously mentioned, the salinities in Biscayne Bay adjacent to the Turkey Point site and Card Sound are most affected by the amount of precipitation that falls in and around the bay and the sound. Also, depending on the hydraulic head in the underlying Biscayne aquifer relative to the head (water levels) in Biscayne Bay, water in the Biscayne Bay (and therefore salt), either moves from Biscayne Bay into the underlying aquifer or from the underlying aquifer into Biscayne Bay.

Within Biscayne Bay and Card Sound, near-shore areas next to the mainland have a larger range of salinity values than mid-bay or mid-sound locations. This is because near-shore areas are more affected by freshwater inflows and evaporation than mid-bay and mid-sound locations (NRC 2016a).

The surface water monitoring program, which, in addition to surface water samples, includes pore water samples and shallow monitor well samples in the Bay, has not detected a discernable effect from the CCS on the salinity of Biscayne Bay or Card Sound (FPL 2016a, FPL 2018f).

Ammonia and Nutrients and Salinity within Marsh Land and Mangrove Areas

The monitoring program has not detected evidence in the surrounding marsh and mangroves areas of any impacts of ammonia, nutrients, or salinity from the CCS on soil pore water quality via the groundwater pathway (FPL 2014b, 2016a, 2017a, 2018f).

Ammonia and Nutrients and Salinity within Adjacent Canals

On the west side of the CCS, the interceptor ditch (which is about 18 ft (5.5 m) deep), serves to keep groundwater under the CCS from moving west into the L-31E canal. However, there is no interceptor ditch along the southern boundary of the CCS (Figure 3-4). Within the CCS, the canal that runs along the southern boundary is 20 ft (6.1 m) deep. The S-20 canal and the Card Sound remnant canal lie adjacent to the CCS with no intervening interceptor ditch. At these locations, the S-20 Canal is 5 ft deep and the Card Sound remnant canal is more than 20 ft (6.1 m) deep (FPL 2014b). Therefore, due to their close proximity to the CCS, these are locations where CCS water may more readily move into an adjacent canal via the groundwater pathway.

With the following exceptions, no readily apparent impacts of ammonia, other nutrients, and salinity on surface water quality in canals adjacent to the Turkey Point site, from the CCS via the groundwater pathway, have been detected (FPL 2016a). During the June 2014 to May 2015 monitoring period, monitoring detected an intermittent influence from the CCS at two monitoring locations in canals immediately adjacent to the CCS. One station is located in the S-20 canal and one station is located in the Card Sound remnant canal. The identification of CCS influence was determined based on small temperature variations and higher tritium and salinity values than would normally be expected. However, no readily discernible influence from the CCS was detected at these locations during the June 2013 to May 2014 monitoring period or the June 2016 to May 2017 monitoring period (FPL 2012a, FPL 2014b, FPL 2017a). Minimal, if any, influence on surface water quality was detected where the canals connect to Card Sound (FPL 2016a).

On July 10, 2018, the Miami-Dade County DERM issued a letter stating that total ammonia concentrations at some sampling locations in the Card Sound remnant canal, the S-20 canal, and in the Sea-Dade remnant canal, exceeded the applicable Miami-Dade County surface water standard. This letter acknowledged that the elevated surface water ammonia concentrations may be attributable to several contributing sources, including factors not directly related to the operation of the CCS; however, based on an evaluation of tritium concentrations and temperature data, the DERM found that the CCS is a contributing source to the ammonia concentrations in these areas (MDC 2018a). The DERM also acknowledged that the management of water quality within the CCS may be effective in reducing water quality impacts beyond the CCS boundaries, and it required FPL to submit a plan to address CCS nutrient impacts to groundwater and surface water resources beyond the boundaries of the CCS (MDC 2018a).

3.5.2 Groundwater Resources

Groundwater includes all water below the ground surface, usually within a zone of saturation. Aquifers contain groundwater in sufficient volume to supply wells, springs, and surface water.

3.5.2.1 Hydrogeology and Aquifers

The NRC staff's EIS for the Turkey Point, Units 6 and 7 combined licenses (NUREG–2176) contains an extensive description and evaluation of the hydrogeologic system of the southern Miami-Dade County region, focusing on the Turkey Point site (NRC 2016a). The summaries of site hydrogeology in this section of the SEIS are primarily based on NUREG–2176, as well as on FPL's environmental report submitted as part of the Turkey Point subsequent license renewal application (FPL 2018f). Where appropriate, the NRC staff has summarized referenced information or incorporated information by reference into this SEIS so that the following subsections can focus on new and potentially significant information since initial license renewal of Turkey Point Units 3 and 4 in 2002. The discussions and analyses that follow focus on aspects of the aquifer systems and the interactions with ongoing Turkey Point operations including the CCS, also called the industrial wastewater (IWW) facility. For a detailed description of the CCS, see Section 3.1.3, "Cooling and Auxiliary Water Systems," of this SEIS.

Two major aquifer systems underlie the region and the Turkey Point site: (1) the surficial aquifer system consisting of the Biscayne aquifer, and (2) the deeper Floridan aquifer system (FPL 2018f, NRC 2016a). Figure 3-6 in Section 3.4 of this SEIS shows the orientation, depths, and thicknesses of the aquifers beneath the Turkey Point site, including the named stratigraphic units and the lithologies (rock types) comprising them.

During the NRC staff's June 2018 environmental site audit (NRC 2018c), the staff toured the facilities and locations discussed below, including the CCS and related structures, Upper Floridan aquifer production (i.e., CCS freshening) well locations, hypersaline recovery wells and the associated deep injection well, and the Turtle Point and Barge Basin restoration project sites.

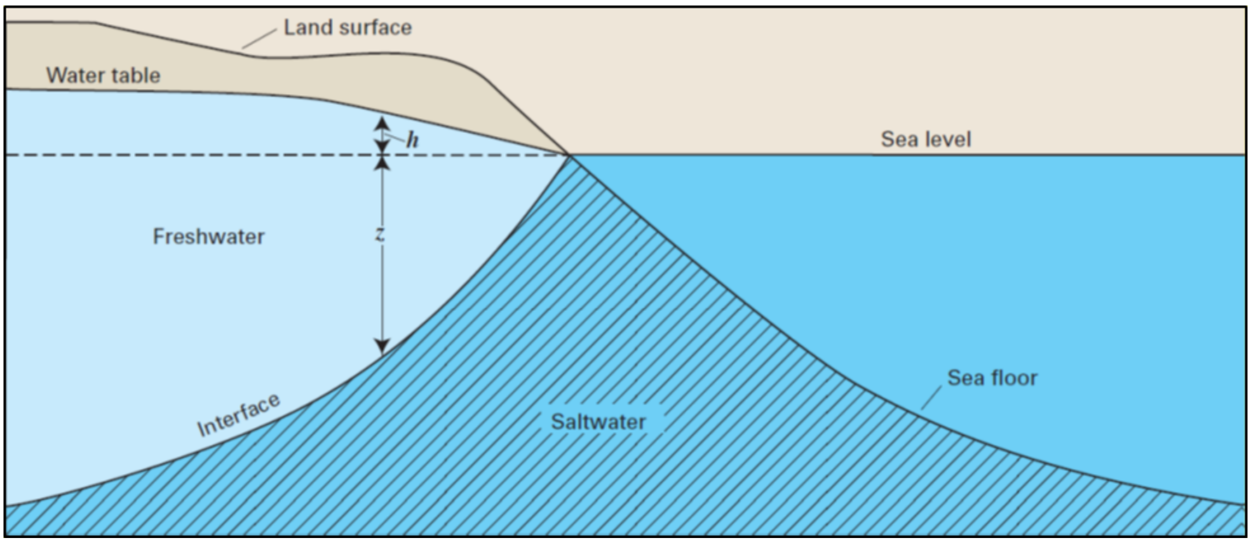
<u>Biscayne Aquifer</u>

As illustrated in Figure 3-6 (see Section 3.4) and as described in NUREG–2176 (NRC 2016a), the Biscayne aquifer is the principal aquifer beneath southeast Florida that is used for water supply. It extends from the land surface to a depth of approximately 140 feet (43 m) beneath the Turkey Point, Units 3 and 4 site. It is generally an unconfined (water table) aquifer, but it may be semiconfined or confined on a localized basis due to the occurrence of less permeable strata (FPL 2018f, NRC 2016a).

Section 2.3.1.2, "Hydraulic Properties of Biscayne Aquifer," of NUREG–2176 (NRC 2016a) describes the permeable limestones and calcareous sandstones forming the Biscayne aquifer as highly heterogeneous with varying hydraulic properties that may comprise one or more aquifers separated by locally confining units. Section 2.3.1.2 of NUREG-2176 also describes the differences and the inherent hydrogeologic properties of the Biscayne aquifer including porosity, transmissivity, and hydraulic conductivity (NRC 2016a: 2-49-2-51). The NRC staff incorporates that information into this SEIS by reference.

The low topographic relief of the Turkey Point site relative to sea level makes the site subject to tidal inundation. As such, the waters of the Biscayne aquifer are highly saline below the Turkey Point site. To the east of the site, the Biscayne aquifer is recharged by the saline waters of Biscayne Bay. Freshwater recharge of the Biscayne aquifer occurs from precipitation primarily during the wet season (June to October) with minimal recharge during the dry season (November to May). It is likely that some freshwater recharge also occurs during the wet season from freshwater marshes and sheet flow runoff. Seepage from freshwater canals usually continues to recharge the aquifer during the dry season (NRC 2016a). In general, the Biscayne aquifer water table responds rapidly to precipitation as well as to tidal fluctuations (FPL 2018f).

Under natural conditions and with adequate inland recharge of freshwater, the water table in a surficial aquifer like the Biscayne aquifer is higher than the average sea-level elevation, which balances the higher density of seawater. In such a case, the freshwater-saltwater interface (interface), the most inland point marking the diffusion boundary between freshwater and seawater, is relatively stable near the coastline or offshore. This is conceptually illustrated in Figure 3-11.



Source: Barlow 2003

Figure 3-11 Generalized Diagram of the Freshwater-Saltwater Interface in a Coastal Water Table Aquifer

When the aquifer water table is lowered by pumping or canal drainage, saltwater can move inland, usually at the base of the aquifer because of the higher density of seawater relative to freshwater. Prior to urban and agricultural development and the construction of canals to drain inland areas, wet season recharge to groundwater was greater than it is today and subsurface flows of groundwater into Biscayne Bay adjacent to the Turkey Point site were also higher (NRC 2016a).

Regionally, reduced surface water runoff and groundwater discharge to Biscayne Bay, combined with pumping of groundwater for irrigation, water supply, and other uses, has caused saltwater to migrate inland along the base of the Biscayne aquifer. This process is known as saltwater intrusion or encroachment (FPL 2018f, NRC 2016a).

The Turkey Point cooling canal system (CCS) (described in Section 3.1.3, "Cooling and Auxiliary Water Systems") is a large, enclosed, hypersaline (i.e., having a salinity greater than that of natural seawater, with chloride concentration exceeding 19,000 mg/L) water body, formed by excavation into the underlying bedrock. The CCS affects the hydrology and groundwater quality of the Biscayne aquifer. The CCS is unlined and hydraulically connected to the upper Biscayne aquifer because permeable aquifer strata permit the movement of water between the aquifer and the CCS. The rate and direction of this water movement depend on the head differences between the CCS and the Biscayne aquifer (FPL 2018f, NRC 2016a). Because of the movement of the hypersaline CCS water into the Biscayne aquifer, there is an area of higher salinity water in the aquifer beneath the CCS and adjoining portions of the Turkey Point site, called the hypersaline plume. As FPL describes in its environmental report, over the operational life of the CCS, the annual average salinity of both the waters within the CCS and within the hypersaline plume beneath it in the Biscayne aquifer have increased. Over the operational life of the CCS, the size of the hypersaline plume has also grown larger. In its environmental report, FPL states that the hypersaline plume now extends out approximately 1.5 mi (2.4 km) west of the CCS boundary (FPL 2018f).

In the wider vicinity of Turkey Point, the regional groundwater flow in the Biscayne aquifer is generally to the east towards the coast. However, more directly under and near the Turkey Point site, groundwater flow is affected locally by tides and drainage canals (NRC 2016a). In the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses, Section 2.3.1.2, "Groundwater Flow Direction," (NUREG–2176) (NRC 2016a) describes in some detail the complex flow interactions between the CCS, the operation of the CCS interceptor ditch and adjacent L-31E Canal, and the hydrologic and density-driven dynamics of the hypersaline plume. As mentioned in the previous paragraph, the hypersaline plume has grown in size and moved laterally beyond the CCS and the bordering L-31E Canal, predominantly to the west within the deeper part of the Biscayne aquifer. The NRC staff incorporates the information in Section 2.3.1.2 of the COL EIS here by reference (NRC 2016a: 2-51, 2-53). In this SEIS, Section 3.1.3.2, "Cooling Canal System (CCS)," describes the interceptor ditch. The current extent of the hypersaline plume emanating from the CCS and its effects on groundwater quality and saltwater intrusion are further discussed below in Section 3.5.2.2, "Groundwater Quality."

Intermediate Confining Unit

Separating the surficial Biscayne aquifer and the Floridan aquifer system is the hydrogeologic unit called the Intermediate Confining Unit (see Figure 3-6 in Section 3.4). This unit has a generally low permeability and is over 800 feet (240 m) thick beneath the Turkey Point site. It is comprised of extensive layers of clay-rich sediments in the upper part of the unit (NRC 2016a). Sands and limestone lenses comprise the permeable parts of this unit (Figure 3-6). Site information suggests that the thickness ranges from approximately 700 feet (210 m) just to the north of the Turkey Point site (at Unit 5 production well PW-3) to about 1,000 feet (300 m) southwest of the site. The Intermediate Confining Unit serves as an effective aquiclude (an impermeable layer or rock or stratum or sediment) for the Floridan aquifer system throughout the state of Florida (FPL 2018f).

Floridan Aquifer System

The Floridan aquifer system underlies the Intermediate Confining Unit. The system is composed principally of dolomite and limestone and is under confined conditions beneath the Turkey Point site and throughout southeastern Florida. The Floridan aquifer system at the Turkey Point site principally consists of the Upper Floridan aquifer, a middle confining unit, and the saline Lower Floridan aquifer (FPL 2018f, NRC 2016a) (Figure 3-6).

The Upper Floridan aquifer is composed of several thin water-bearing zones interlayered with thick zones of low permeability. Across most of Florida, it is a major source of potable water; however, in southeastern Florida, including Miami-Dade County, the water is brackish and requires treatment to meet drinking water standards. While the aquifer can be 400 feet (120 m) or more in thickness across southeastern Florida, at the Turkey Point site, it is approximately

200 feet (60 m) thick (FPL 2018f). Regionally, groundwater flow in the aquifer is generally west to east across the site toward the coast. This is confirmed by groundwater level data from Upper Floridan aquifer wells located near the Turkey Point site (FPL 2018f, NRC 2016a).

The middle confining unit within the Floridan aquifer system consists of beds of less permeable strata that are more than 1,000 feet (300 m) thick, separating the aquifers above and below (FPL 2018f). As described in Section 2.3.1.2 of NUREG–2176, the middle (Floridan) confining unit generally contains a relatively thin, permeable zone called the Avon Park Permeable (or Producing) Zone (APPZ), and a lower confining zone (see Figure 3-6 in Section 3.4 of this SEIS). However, the Avon Park zone thins to the south and was not identified at the EW-1 exploratory well at Turkey Point (NRC 2016a).

The upper part of the Lower Floridan aquifer is comprised of low permeability (confining layer) rocks; the deeper part of the Lower Floridan aquifer is a well-developed, highly permeable karst region of fractured carbonate rock known as the Boulder Zone (FPL 2018f, NRC 2016a). The high permeability of the Boulder Zone has been attributed to a network of horizontal caverns at varying depths connected by vertical tubes. Water quality in the Boulder Zone is similar to modern seawater. Within the Boulder Zone, it appears that seawater moves westward from a connection with the Atlantic Ocean off the coast at a depth of about 2,500 feet (760 m). At the Turkey Point site, the top of the Boulder Zone has been identified at a depth of 3,030 feet (994 m). This depth is consistent with statewide mapping (NRC 2016a).

3.5.2.2 Groundwater Quality

<u>Groundwater Quality Standards and Current Designated Uses</u>

The FDEP classifies groundwater within the State of Florida according to present and future "most beneficial uses." The State of Florida establishes water quality standards to protect designated uses (FAC R62-520.300). Florida categorizes groundwater in one of five classes (FAC R62-520.410). These five classes generally relate to the level of potability (i.e., use for drinking and related purposes) as determined by total dissolved solids (TDS) content.

- Class F-I: Potable water use, groundwater in a single source aquifer described in FAC R62 520.460, with a total dissolved solids content of less than 3,000 mg/L and specifically reclassified as Class F-I by the Florida Environmental Regulation Commission.
- Class G-I: Potable water use, groundwater in a single source aquifer that has a total dissolved solids content of less than 3,000 mg/L and specifically reclassified by the Florida Environmental Regulation Commission.
- Class G-II: Potable water use, groundwater in aquifers with a total dissolved solids content of less than 10,000 mg/L, unless otherwise classified by the Florida Environmental Regulation Commission.
- Class G-III: Nonpotable water use, groundwater in unconfined aquifers with a total dissolved solids content of 10,000 mg/L or greater; or with a total dissolved solids content of 3,000-10,000 mg/L and either reclassified by the Florida Environmental Regulation Commission as having no reasonable potential as a future source of drinking water or designated by the FDEP as an exempted aquifer.
- Class G-IV: Nonpotable water use, groundwater in confined aquifers with a total dissolved solids content of 10,000 mg/L or greater.

The State of Florida provides single-source aquifers—those aquifers it identifies as the only reasonably available source of potable water to a significant segment of the population—with the highest level of protection. The FDEP designates such aquifers as Class F-1 and G-I, which have TDS concentrations of less than 3,000 mg/L (FAC R62-520.410). For comparison, the Federal drinking water standard or secondary maximum contaminant level (MCL) for TDS is 500 mg/L (40 CFR 143.3). This secondary standard is based on aesthetic considerations (i.e., taste, color, and odor) and the constituent does not present a risk to human health at the specified level. The FDEP has adopted the same secondary standard for Florida drinking water (FDEP 2018b).

Beneath the Turkey Point site and across southeastern Miami-Dade County, the quality of groundwater within the Biscayne and Floridan aquifer systems varies greatly due to the interaction of natural as well as human-induced factors over time. This is most apparent in the surficial Biscayne aquifer as saltwater intrusion (encroachment) has occurred under a large area of the southeast Florida coast, including under the Turkey Point site.

The NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) cites a U.S. Geological Survey (USGS) study (Prinos et al. 2014) investigating the origins and extent of saltwater intrusion in the Biscayne aquifer. In the study, the USGS presented its analysis of tritium measurements from USGS monitoring wells within about 6 mi (10 km) of the Turkey Point site, which indicated that water from the CCS may contribute to saltwater encroachment in areas northwest of the CCS (Prinos et al. 2014).

FPL states in its environmental report (FPL 2018f) that, even before construction of the CCS in the mid-1970s, the Biscayne aquifer near the Turkey Point site was saline for the full depth of the aquifer, and saltwater intrusion into the Biscayne aquifer had already occurred several miles inland (FPL 2018f). This is supported by information in the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176), Section 2.3.3.2 and Figure 2-22. The NRC staff incorporates Section 2.3.3.2 and Figure 2-22 of NUREG–2176 into this SEIS by reference. NUREG–2176, Figure 2-22 depicts various mapped estimates by the USGS and others of the saltwater interface over the period of 1951 to 2008. These USGS historic estimates depict interface locations that are no less than about 4 mi (6.6 km) west and northwest of the CCS. NUREG–2176, Section 2.3.3.2 contains the NRC staff's characterization of factors contributing to saltwater intrusion, including contributions from the CCS (NRC 2016a: 2-68, 2-69).

Inland migration of the saltwater interface within the Biscayne aquifer continues across the region. Based on a recent USGS estimate, the saltwater interface has moved inland across portions of southeastern Miami-Dade County, west and north of the Turkey Point site, at an average rate of 460 feet (140 m) per year (Prinos 2017). Figure 3-12 below depicts the current location of the saltwater interface at the base of the Biscayne aquifer in relation to the Turkey Point site, the CCS, and groundwater monitoring wells maintained by FPL. The saltwater interface is currently located about 4.7 mi (7.6 km) west of the CCS at its closest point, based on the latest (2017) USGS monitoring well data. The mapped location reflects the current estimate of the 1,000 mg/L concentration boundary for chloride at the base of the Biscayne aquifer (Prinos 2017).

In 1983, the FDEP designated as Class G-III (i.e., non-potable use with TDS levels of 10,000 mg/L or greater) the surficial groundwater (Biscayne aquifer) within the Turkey Point plant property, with the west side of the CCS marking the western boundary (FPL 2018f, SFWMD 2009). FDEP has classified groundwater west of the Turkey Point site (i.e., to the west of the site boundary and CCS) as Class G-II, which means potable water use, with TDS levels of less than 10,000 mg/L (FPL 2018f).

In 2014, the FDEP issued an administrative order to FPL. In this 2014 administrative order, the findings of fact state that saltwater was present as early as the 1940s near the base of the Biscayne aquifer west of the Turkey Point site. It further states that groundwater data from the early 1970s (prior to completion of CCS construction in 1973) supported the determination that non-potable groundwater (TDS exceeds 10,000 mg/L) occurred beneath much of the proposed CCS at depth and within the deeper portions of the aquifer west of the site (FDEP 2014).

Through wells located inland of the saltwater interface, the Biscayne aquifer is the major public water supply source across Miami-Dade County as well as for the Florida Keys (NRC 2016a: 2-60). In addition, the EPA has designated the Biscayne aquifer across all of south Florida as a sole-source aquifer pursuant to Section 1424(e) of the Safe Drinking Water Act of 1974 (EPA 2016a, FPL 2018f, NRC 2016a).

The Biscayne aquifer is not the only current or potential source of drinking water in the region. The Upper Floridan aquifer is also an important source of freshwater in parts of Florida. The FDEP designates the Upper Floridan aquifer as an underground source of drinking water because its water has a TDS concentration of less than 10,000 mg/L (FAC R62-528.200, NRC 2016a). However, while the groundwater within the Upper Floridan aquifer contains less than 10,000 mg/L TDS in southeastern Florida, with TDS concentrations greater than 2,000 mg/L, water obtained from the aquifer is too saline to be used for drinking water without treatment (NRC 2016a).

Source: Modified from FPL 2017a Fig. 1.1-1

Figure 3-12 Groundwater Monitoring Locations and Saltwater Interface, Turkey Point Site

Baseline Groundwater Quality and Changes Attributable to Turkey Point Operations

The SEIS for the Turkey Point Units 3 and 4 initial license renewal (NUREG–1437, Supplement 5) (NRC 2002c) documents the NRC staff's environmental review of FPL's application for the initial 20-year license renewal submitted in 2000. Section 2.1.3 of that EIS describes the likely exchange between the canals and groundwater as well as the operation of the CCS and associated interceptor ditch. As stated therein, the operation of the interceptor ditch was intended to prevent the flow of hypersaline water from the cooling canals toward the Everglades (i.e., inland to the west) (NRC 2002c).

Thus, when the NRC staff published its SEIS for the Turkey Point initial license renewal in 2002, the staff acknowledged the existence of a hypersaline plume in the Biscayne aquifer directly beneath the CCS. What was not fully understood at the time was the potential for the hypersaline plume to migrate downward through the Biscayne aquifer and then to move laterally within the Biscayne aquifer beyond the CCS boundaries. The following discussion presents new information on the effects of CCS operations on hypersalinity in the Biscayne aquifer and groundwater quality.

The interaction of water in the CCS (including cooling loop water and stormwater from Turkey Point) with underlying groundwater in the Biscayne aquifer is complex. In the CCS, heat is rejected to the atmosphere primarily through evaporation, resulting in a net loss of water from the canals. As water evaporates from the CCS, the concentration of dissolved substances, principally salts, in the CCS increases. This increases the density of the CCS water. The high rate of evaporation also produces a net inflow of groundwater into the CCS, but the groundwater flux between the CCS and Biscayne aquifer varies by location. The following variables and factors also affect these groundwater interactions between CCS waters and Biscayne aquifer waters:

- precipitation, specifically seasonal precipitation variation during the wet season versus the dry season
- variations in hydraulic head (water table elevation)
- cooling water effluent discharge rate
- air temperature
- humidity
- tidal fluctuations

As a result of the above variables, the direction of water movement into or out of the CCS varies in time and space. Over time, the denser, heated, hypersaline water migrates downward from the CCS into the Biscayne aquifer. The downward movement of hypersaline water is impelled by the increased density because of the elevated salinity of the water in the CCS (NRC 2016a).

In preparing the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a), the NRC staff reviewed modeling performed by Hughes et al. (2010), which used a two-dimensional, cross-section model to evaluate the combined effects of salinity, temperature, and other variables associated with operation of the CCS, including the CCS's contribution to the movement of the saltwater interface. The Hughes modeling demonstrates that the downward migration of hypersaline water takes the form of "finger plumes" that form beneath the CCS and then move downward to the bottom of the permeable zone of the aquifer in a period ranging from days to several years, depending on localized differences in aquifer properties. These finger plume structures then mix with aquifer water through advection and dispersion (NRC 2016a). The modeling also indicates that the inland migration of the saltwater interface is closely related to TDS concentrations in the CCS (Hughes et al. 2010).

FPL operates the interceptor ditch to maintain an eastward hydraulic gradient (toward the CCS). However, this operation has not completely prevented the hypersaline CCS water that enters the Biscayne aquifer from migrating westward. This is primarily because the interceptor ditch only functions to the depth to which it was constructed, as described in Section 3.5.1.1, “Surface Water Hydrology,” thus enabling hypersaline water that has moved to deeper depths in the aquifer to move beyond and west of the interceptor ditch.

Since 2009, FPL has maintained an extensive, multimedia environmental (uprate-related) monitoring program in accordance with Turkey Point’s site certification conditions (i.e., Conditions IX and X), as modified (FDEP 2016b, State of Florida Siting Board 2016) pursuant to the Florida Power Plant Siting Act and related regulatory requirements, stemming from the NRC’s June 2012 approval of the Turkey Point extended power uprate (EPU) project. The focus of this uprate monitoring program is to determine the horizontal and vertical effects of CCS water on the environment. FPL conducts this program in accordance with the 2009 monitoring plan (SFWMD 2009) under the auspices of the FDEP, SFWMD, and the Miami-Dade County Department of Environmental Resources Management (DERM).

FPL completed a period of pre-uprate monitoring in 2012, covering the period of June 2010 through June 2012, and submitted it for interagency review in October 2012 (FPL 2018f, FPL 2012a). Monitoring results are reported in publicly available annual monitoring reports submitted to the FDEP and partner agencies including the South Florida Water Management District and Miami-Dade County. To date, the results of FPL’s groundwater uprate monitoring demonstrate that CCS operations have impacted groundwater quality in the Biscayne aquifer to the west of the L-31E Canal as well as beneath Biscayne Bay to the east (NRC 2016a).

For groundwater monitoring, FPL’s contractor performs quarterly field sampling from 14 well clusters, comprising 42 wells in total. This is in addition to automated water quality and water level measurements at each well (FPL 2017a). Each well cluster consists of three, collocated Biscayne aquifer monitoring wells (i.e., shallow, intermediate, and deep), which are shown above in Figure 3-12.

For each monitoring well, FPL collects and analyzes groundwater samples for 29 separate parameters, including general water quality parameters (e.g., temperature, pH), ionic, and nutrient constituents. Tritium is used as a chemical tracer in order to determine the potential movement of CCS water within the Biscayne aquifer (FPL 2017a, SFWMD 2009). Specifically, by interagency consensus, tritium was established as a tracer for the CCS water with a threshold concentration value for tritium of 20 pCi/L in groundwater (FPL 2012a). Table 3-4 below summarizes the latest available analytical results for selected wells and key monitored parameters.

Table 3-4 Summary of Groundwater Monitoring Results for Selected Biscayne Aquifer Wells (Shallow and Deep Intervals), Turkey Point Uprate Monitoring Program

Parameter Results[(a)], Current (2017)[(b)] and Historic (2011)[(c)]					
Well Number	Chloride	TDS	Salinity (PSU)	Tritium (pCi/L)	Ammonia
TPGW-1S (2017)	16,400*	27,500	28.41	698	1.08
TPGW-1D (2017)	29,900	19,400*	47.60	2,365	1.62*
TPGW-1S (2011)	17,000	27,000	27.8	810	0.87
TPGW-1D (2011)	29,000	50,000	48.1	2,560	1.3
TPGW-2S (2017)	26,700	33,400	41.67	1,955	1.61*
TPGW-2D (2017)	35,800*	43,400	49.95*	3,101	2.22*
TPGW-2S (2011)	30,000	50,000	52.4	3,030	1.5
TPGW-2D (2011)	32,000	52,000	54.2	3,320	1.7
TPGW-4S (2017)	1,220	2,190	2.12	17.4	M
TPGW-4D (2017)	17,200*	19,400	26.82	403	M
TPGW-4S (2011)	670	1,400	1.4	19.4	M
TPGW-4D (2011)	16,000	26,000	28.0	519	M
TPGW-7S (2017)	33.8	270	0.27*	4.2*U	M
TPGW-7D (2017)	3,400*	5,400	5.42	26.6	M
TPGW-7S (2011)	35	300	0.3	13.5	M
TPGW-7D (2011)	42	310	0.3	2.2	M
TPGW-9S (2017)	23.3	334	0.29*	9.7*U	M
TPGW-9D (2017)	25.7	348	0.31*	-4.5*U	M
TPGW-9S (2011)	20	330	0.3	10.6	M
TPGW-9D (2011)	28	350	0.3	1.5	M
TPGW-10S (2017)	21,800*	28,600	36.25	69.1	0.56
TPGW-10D (2017)	28,400	36,100	47.68	1,690	1.45
TPGW-10S (2011)	19,000	33,000	33.8	18.4	0.32
TPGW-10D (2011)	22,000	36,000	37.4	8.2	0.22
TPGW-11S (2017)	23,500	17,400*	36.17	-5.6*U	M
TPGW-11D (2017)	26,900	35,300	44.3	1,066	M
TPGW-11S (2011)	22,000	36,000	36.9	2.4	M
TPGW-11D (2011)	24,000	39,000	39.3	435	M
TPGW-13S (2017)	36,500	47,700	55.8	4,122	3.69*
TPGW-13D (2017)	34,800	48,000	58.27	3,674	3.66*
TPGW-13S (2011)	38,000	61,000	61.6	3,800	2.8
TPGW-13D (2011)	37,000	59,000	59.2	3,830	1.6
TPGW-14S (2017)	22,900	29,100	39.03	91.5	0.551
TPGW-14D (2017)	32,800	37,600	49.5	2,234	2.33
TPGW-14S (2011)	24,000	39,000	40.0	247	0.54
TPGW-14D (2011)	32,000	52,000	51.8	2,660	1.6*-

Notes: D=deep well; S=shallow well; TDS=total dissolved solids. *=Denotes result qualified as estimated (+/- indicates bias); M=Denotes missing data; U=Indicates analyzed for but not detected at the reported value.

Some results in the table may be rounded.

Parameter Results[a], Current (2017)[b] and Historic (2011)[c]
[a] All units are reported in milligrams per liter (mg/L) except salinity (reported in practical salinity units (PSU) based on the practical salinity scale of 1978) (unitless) and tritium (picoCuries per liter (pCi/L) with 1σ uncertainty error omitted). Ammonia is reported as total ammonia nitrogen.
[b] Analytical results from the March 2017 quarterly sampling event (FPL 2017a).
[c] Analytical results from the March 2011 quarterly sampling event (FPL 2012a).
Source: FPL 2012a, FPL 2017a.

Monitoring well locations were established based on FPL and interagency consensus and criteria as documented in the 2009 monitoring plan (SFWMD 2009). The wells are located such that monitoring will be able to detect changes in groundwater quality, including migration of the hypersaline plume, both in the near field (adjacent to the CCS) and at representative far-field locations (i.e., at distances not currently identified as having been affected by CCS water). For example, wells TPGW-13S/D are at the approximate center of the CCS, the source of the hypersaline plume. Wells TPGW-1 through TPGW-7 are situated at various distances to the north and west of the CCS. Well cluster TPGW-7S/D can also be considered a sentinel well as it is the monitoring location nearest to the Miami-Dade County's Newton Wellfield that supplies potable water to municipal customers. Well location TPGW-9S/D is a reference well location reflecting groundwater conditions unaffected by the CCS and located upgradient (west) of the saltwater interface. Well locations TPGW-10S/D, TPGW-11S/D, TPGW-13S/D, and TPGW-14S/D are offshore in Biscayne Bay.

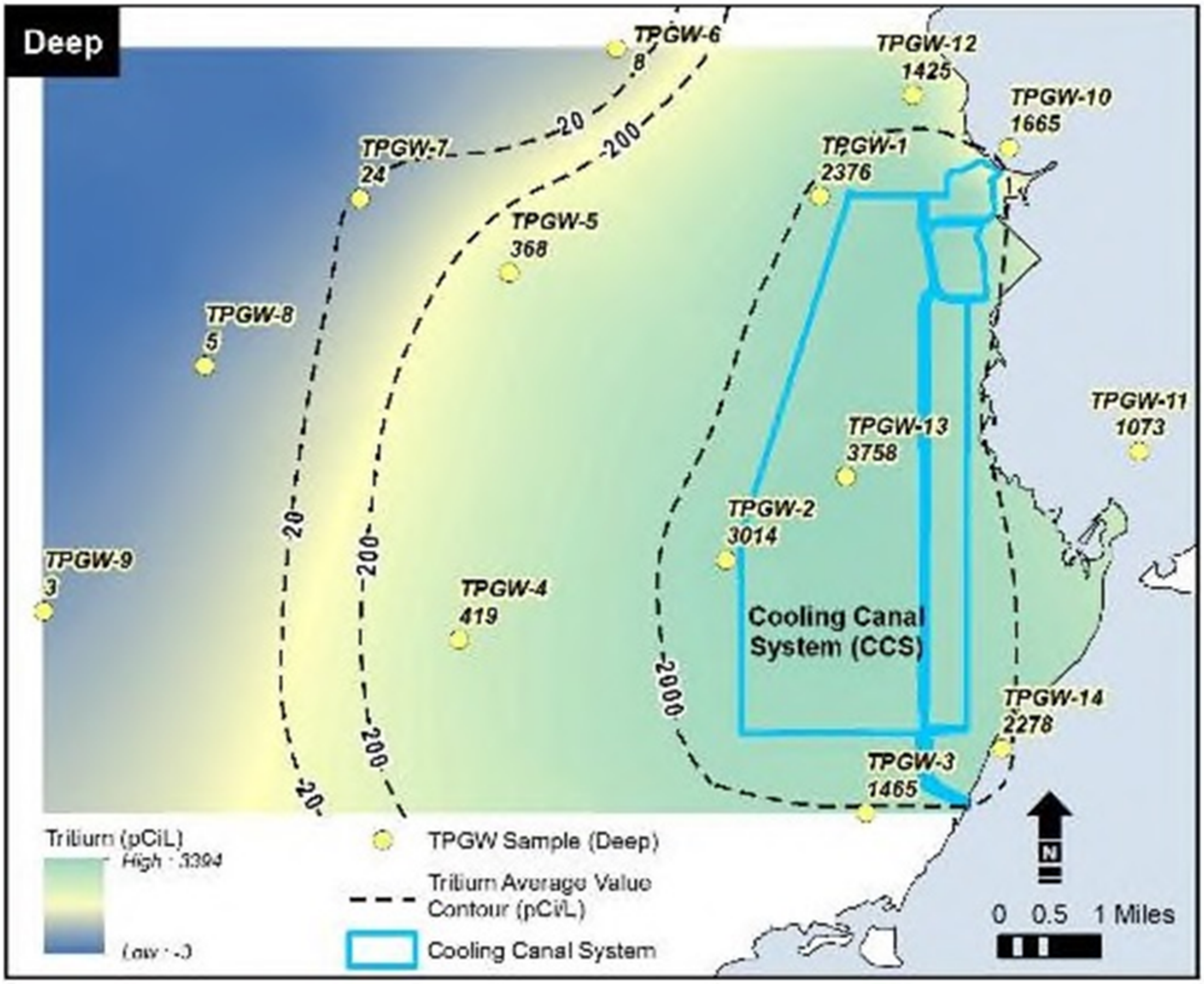
As summarized in Table 3-4 above, the analytical results from FPL's monitoring program include the deep-screened interval (Biscayne aquifer) of the listed well locations that corresponds to the base of the Biscayne aquifer, as well as from the shallow (upper) interval, in order to identify any vertical differences in water quality parameters. It is in the lower intervals of the aquifer where hypersaline water from the CCS would be expected to preferentially move, as well as where migration of the regional saltwater interface would first be evident.

Further, Table 3-4 compares quarterly groundwater sampling results for the same seasons (i.e., March 2011 and March 2017) so that results for monitored parameters at the well locations can be compared over time. March is near the end of the dry season across southeast Florida and is the timeframe where the effects of CCS water incursion would likely be more discernible. Additionally, data from March 2011 are included to provide an historical baseline, representing the pre-extended power uprate monitoring period for Turkey Point.

The NRC staff has used current (2017) and historical groundwater monitoring data to document baseline groundwater quality as well as changes in quality in the Biscayne aquifer within and adjacent to the Turkey Point site. The results reflect the current FDEP classification for Class G-III groundwater (i.e., TDS of 10,000 mg/L or greater) in the area of the site, corresponding to the western boundary of the CCS and encompassing the Turkey Point property to the east. The current monitoring data (Table 3-5) also establish that TDS concentrations in Class G-II designated groundwater immediately to the west of the CCS boundary exceed the G-II standard (TDS of less than 10,000 mg/L). Monitoring results further show the influence of CCS operations on groundwater quality beneath the CCS within the Biscayne aquifer and adjacent to the CCS, particularly as reflected in data for wells TPGW-2D and TPGW-4D. More precisely, the data presented in Table 3-4 as well as in the broader quarterly monitoring data sets (June 2016, September 2016, December 2016, and March 2017) for these wells (FPL 2017a) generally show an increasing vertical trend with depth (i.e., from the shallow to the deep monitored intervals) in chloride, TDS, and tritium concentrations at these locations. This is indicative of the influence of CCS water in the deep interval of the Biscayne aquifer. This is further reflected in data for the June 2013 to May 2015 monitoring periods (FPL 2016a).

Similarly, tritium levels measured in wells to the east of the CCS in Biscayne Bay (i.e., TPGW-10, TPGW-11, and TPGW-14) suggest the influence of CCS water, at least in the deep interval of the Biscayne aquifer. For all monitored parameters at these groundwater locations (TPGW-2, -4, -10, -11, and -14), the NRC staff observes that the influence of CCS water was evident prior to implementation of the extended power uprate beginning in 2012.

In summary, the NRC staff concludes that hypersaline groundwater in the Biscayne aquifer exists under and adjacent to the CCS, with hypersaline conditions diminishing with increased distance from the CCS. According to FPL's 2017 annual monitoring report, the extent of "potential CCS influence" is 4.5 mi (7.2 km) west of the CCS. This line of influence is based on the current estimate of the 20 pCi/L concentration boundary for tritium in groundwater, with the mapped contour line passing just west of monitoring well TPGW-7D, which is depicted below in Figure 3-13. It should be noted that tritium readings of 20 pCi/L are not significant; for comparison, the EPA's primary drinking water standard or maximum contaminant level for tritium is 20,000 pCi/L (40 CFR 141.16).



Source: Modified from FPL 2017a: Fig. 5.1-4

Figure 3-13 Extent of Tritium in the Deep Interval of the Biscayne Aquifer in the Vicinity of the Turkey Point Site, 2017

As described in FPL's 2017 annual monitoring report, FPL had previously estimated the historical limit, prior to CCS construction, of Class G-III groundwater (non-potable water with a TDS content of 10,000 mg/L or greater). FPL based this estimate on historical TDS values from groundwater wells. Where historical TDS values were not directly available, FPL used the relationship between measurements of specific conductance and TDS to estimate historical TDS values. The 2017 annual monitoring report concludes that most of the Biscayne aquifer currently affected by the CCS never contained potable water (FPL 2017a).

Nevertheless, and as FPL's 2017 annual monitoring report notes, monitoring has shown increases in one or more constituents (e.g., chloride, tritium) in several wells over the last 4 to 5 years that indicate the expansion of more saline groundwater. These wells include TPGW-7D, TPGW-10D, and TPGW-11D. At TPGW-7D, the water transitioned from fresh to brackish between the summer of 2013 and January 2017. FPL attributed the increase in observed ion concentrations (e.g., chloride) to advance of the saltwater interface, but remained uncertain about the source of the higher tritium levels (i.e., 26.6 pCi/L in 2017 versus 2.2 pCi/L in 2011, see Table 3-4) (FPL 2017a). Meanwhile, wells TPGW-10D and TPGW-11D, just east of the CCS in Biscayne Bay, have exhibited increases in conductance, chloride, and tritium since 2013. FPL's 2017 annual monitoring report suggests that the increase in tritium in these wells indicates "a potential increase in the amount of CCS-sourced groundwater compared to the original marine groundwater" (FPL 2017a).

Current (2017) water quality monitoring results and other available well data show that a fresher groundwater lens (i.e., lower chloride and TDS concentrations) exists in the upper (i.e., 18 to 20 ft (5.5 to 6.1 m)) interval of the Biscayne aquifer just to the west of the CCS. This lens generally thickens to over 50 feet (15 m) in depth at TPGW-7 (see Figure 3-12). Here, in the shallow interval at this monitoring location (TPGW-7S), the groundwater appears to meet the Class G-II criterion for potable water use with a TDS content of less than 10,000 mg/L (see Table 3-4). At a distance of over 5.5 mi (8.9 km) west of the CCS (e.g., at TPGW-9, see Table 3-4 and Figure 3-12), the aquifer is presently fresh at all depths (FPL 2017a).

<u>Regulatory Developments with Respect to Cooling Canal System Operations and Groundwater Quality</u>

As discussed above, beginning in 2010, FPL implemented an expanded groundwater monitoring program in support of Turkey Point's extended power uprate and associated regulatory approvals. This expanded groundwater monitoring program helped to identify the need for FPL to take corrective actions to address onsite and offsite impacts associated with operation of the CCS, especially involving salinity, chloride, and ammonia concentrations (FPL 2018f: 3-90, 3-91). In consultation with and at the direction of State and local regulatory agencies, since 2013, FPL has undertaken a number of actions to mitigate impacts associated with CCS operation. Most of these actions focus on reducing high salinities within the CCS. Most recently, these actions included active measures to halt and remediate the migration of the hypersaline plume from the CCS. This section of the SEIS presents a brief summary of the history, the current status, and the scope of the associated regulatory mechanisms governing FPL's actions focusing on groundwater quality issues.

In December 2014, the FDEP issued an administrative order to FPL directing, in part, that FPL develop a salinity management plan for the CCS along with additional monitoring requirements (FDEP 2014a, FPL 2018f). Several entities, including Miami-Dade County, challenged the FDEP's 2014 administrative order.

On October 2, 2015, Miami-Dade County issued a notice of violation (NOV) to FPL alleging violations of county water quality standards and criteria in groundwater beyond the boundaries of the CCS and FPL property (FPL 2018f, MDC 2015a). Subsequently, on October 7, 2015, Miami-Dade County and FPL entered into a consent agreement (the 2015 Consent Agreement). In the 2015 Consent Agreement, the County recognized the salinity reduction efforts that FPL was already undertaking including the use of onsite marine production wells and plans to construct six wells to withdraw water from the Upper Floridan aquifer for CCS salinity reduction. The 2015 Consent Agreement requires FPL to evaluate alternative water sources to offset water deficits in the CCS and to reduce chloride concentration in the CCS, including the use of reclaimed wastewater from the Miami-Dade South District Wastewater Treatment Plant (FPL 2018f, MDC 2015a). Moreover, the 2015 Consent Agreement specifically requires FPL to maintain measures to abate hypersaline water discharges and to actively remediate the hypersaline groundwater west and north of FPL's property, without creating adverse environmental impacts. The stipulated remedial action is the installation and operation of a Biscayne aquifer recovery well system to intercept, capture, and retract the hypersaline plume from the CCS to within FPL's property boundary, along with associated deep well disposal of the extracted hypersaline groundwater. The Consent Agreement also requires that FPL conduct additional monitoring, submit annual reports and undertake surveys (i.e., continuous surface electromagnetic mapping of the hypersaline plume) to gauge progress toward meeting the terms of the agreement. Finally, FPL is required to review, report, and consult on any necessary changes related to the effectiveness of the recovery well system at 5-year and 10-year intervals (MDC 2015a).

On August 15, 2016, FPL and Miami-Dade County executed an addendum revising the 2015 Consent Agreement. The revised agreement (the 2016 Addendum) requires FPL to take action to evaluate and address alleged violations of Miami-Dade County water quality standards and cleanup target levels relating to the exceedance of ammonia standards in surface water, including deep remnant canals adjacent to the Turkey Point CCS. The 2016 Addendum further requires that FPL prepare a site assessment report to identify the sources of ammonia exceedances and to delineate their extent in surface water in accordance with a site assessment plan approved by Miami-Dade County (MDC 2016a). On December 29, 2016, in response to the County's comments on the draft site assessment plan, FPL submitted an amended site assessment plan, and it initiated environmental sampling on January 3, 2017, as approved by Miami-Dade County (FPL 2017b). FPL submitted its completed site assessment report to the County on March 17, 2017 (FPL 2017c).

The completed ammonia site assessment report documents the results of FPL's sampling and analysis program to assess the nature and extent of ammonia in surface waters near the Turkey Point site and in the CCS. It includes sampling results from numerous surface water, porewater, canal water, and groundwater sampling locations as well as stratified surface water sampling. With respect to groundwater, FPL sampled nine monitoring wells completed in the Biscayne aquifer, including: (1) four wells northeast of the Turkey Point power block (FTF-SW, FTF-NW, FTF-SE, MW-5), (2) two wells east of the power block (MW-3, MW-4) adjacent to the discharge canal and Biscayne Bay, (3) two wells (South MW, North MW) southeast of the power block near FPL's sanitary injection well and discharge canal, and (4) one deeper well located south of the Turkey Point complex in the mud flat area known as Mud Island (C6-5). While all wells had detectable ammonia, the concentrations were variable, ranging from a low of 0.17 mg/L at MW-3 adjacent to the intake canal and Biscayne Bay to a high of 4.6 mg/L at the South MW, as compared to the surface water quality standard of 0.5 mg/L. The report states that the high concentration of ammonia at South MW and relatively fresh water in the well may be caused by the sanitary wastewater injection well. Well C6-5 had the second highest ammonia concentration (2.48 mg/L). This deeper well (C6-5) at 90 feet (27 m) was the only well sampled that also exhibited hypersalinity (52.2 PSU), indicating potential CCS influence (FPL 2017c).

In July 2017, Miami-Dade County requested that FPL collect additional data in support of the ammonia site assessment report (FPL 2017b). In November 2017, FPL responded to the County's request by submitting supplemental information. In a July 18, 2018 letter, the County informed FPL that it had completed its review of the site assessment report and supplemental information. The County's letter states that based on its review of FPL's ammonia data as well as its review of historical groundwater monitoring data collected from the TP-GW series uprate monitoring wells (e.g., TPGW-1, TPGW-2, TPGW-10, TPGW-13, and TPGW-14), there is a "statistically significant increasing trend" in ammonia concentrations in groundwater in the intermediate and deep intervals along with a concentration gradient emanating from the CCS. The County's letter directs FPL to undertake a number of additional actions, including development of a revised sampling plan for ammonia in surface water and groundwater and measures to reduce nutrient impacts from the CCS on surface waters and groundwater (MDC 2018a). Surface water sampling results from the ammonia site assessment report are discussed in Section 3.5.1.4, "Adjacent Surface Water Quality and Cooling Canal System Operation," of this SEIS.

Separately, the FDEP issued a modified final administrative order to FPL on April 21, 2016 (the 2016 Final Administrative Order) (FDEP 2016h, FPL 2018f). The FDEP's 2016 Final Administrative Order concludes, in part, that "the preponderance of the record evidence indicates the CCS is the major contributing cause of the continuing westward movement of the saline water interface" (FDEP 2016h).

On April 25, 2016, the FDEP issued a warning letter (FDEP 2016c) expressing concern that CCS water was reaching Biscayne Bay. Concurrently, the FDEP issued a notice of violation to FPL that incorporated findings from the FDEP's April 21, 2016 Final Administrative Order and specifically directed FPL to enter into consultations to develop a consent order for corrective actions to abate the CCS contribution to the hypersaline plume, reduce the size of the hypersaline plume, and prevent future harm to waters of the State (FDEP 2016d, FPL 2018f).

To resolve the warning letter and notice of violation, FPL and the FDEP executed a consent order on June 20, 2016 (the 2016 FDEP Consent Order) (FDEP 2016e). The 2016 FDEP Consent Order contains three primary objectives (FDEP 2016e, FPL 2018f) as well as the methods FPL must use to meet each objective. The three objectives are as follows:

- First Objective. Cease discharges from the CCS that impair the reasonable and beneficial use of the adjacent Class G-II groundwater by maintaining the average annual salinity of the CCS at or below 34 PSU, by undertaking freshening activities, by eliminating the CCS contribution to the hypersaline plume, by halting the westward migration of hypersaline water from the CCS, and by reducing the westward extent of the hypersaline plume to the L-31E Canal within 10 years, thereby removing its influence on the saltwater interface without creating adverse environmental impacts.
- Second Objective. Prevent releases of groundwater from the CCS to surface waters connected to Biscayne Bay that result in exceedances of surface water quality standards in Biscayne Bay.
- Third Objective. Provide mitigation for impacts related to the historic operation of the CCS, including but not limited to the hypersaline plume and its influence on the saltwater interface. (FDEP 2016e)

The First Objective of the 2016 FDEP Consent Order primarily involves reducing salinity in the CCS and thereby also reducing the CCS contribution to the hypersaline plume in the Biscayne Aquifer and the plume's westward migration. Since 2015, FPL has been using a variety of water sources to manage salinity within the CCS. It has also implemented a number of additional CCS operational and surface water quality management measures as required by the 2016 FDEP Consent Order, which are discussed in Section 3.5.1.2, "Surface Water Hydrology," of this SEIS.

With regard to meeting the 34 PSU salinity metric specified in the 2016 FDEP Consent Order and consistent with the requirements of the 2015 Consent Agreement with Miami-Dade County, FPL commenced operation of a new freshening well system on November 28, 2016, adding groundwater from the Upper Floridan aquifer to the CCS. The State of Florida authorizes FPL to withdraw up to 14 mgd (53,000 m^3/day) from the Upper Floridan aquifer from six wells under its modified site certification for the Turkey Point site; FPL has constructed five wells to date (i.e., wells F-1, F-2, F-3, F-4, and F-5) (FDEP 2016b, State of Florida Siting Board 2016). By adding brackish (i.e., average of 2.5 PSU) Upper Floridan aquifer groundwater to the CCS, FPL intends to minimize the increase in salinity that can occur in the CCS during the yearly dry season, reduce average CCS salinity to meet the 2016 FDEP Consent Order metric of 34 PSU, and reduce the CCS contribution to the existing hypersaline plume (FPL 2018f). Section 3.5.2.3, "Groundwater Use," in this SEIS contains a separate discussion of groundwater withdrawals associated with salinity reduction and other activities at the Turkey Point site.

In order to stop and then retract the westward migration of hypersaline groundwater originating from the CCS, the 2016 FDEP Consent Order requires FPL to permit, construct, and operate a recovery well system to remediate the hypersaline plume in the Biscayne aquifer (FDEP 2016e). This requirement is consistent with the 2015 Consent Agreement (MDC 2015a) between FPL and Miami-Dade County, as described previously.

From September 2016 until mid-2018, FPL conducted hypersaline extraction and deep well injection testing, which had the benefit of initiating salt removal from the Biscayne aquifer. In 2013, FPL had sought and obtained permission from FDEP to permit Deep Injection Well DIW-1 as a Class I injection well by converting the existing Class V exploratory well (EW-1), originally installed for the proposed new reactors, Turkey Point Units 6 and 7 (FDEP 2013). FPL used the existing deep injection well (DIW-1) and four, 90-feet (27-m) deep Biscayne aquifer production wells (designated PW-1 through PW-4) constructed by FPL for assessing flow rates for the recovery wells (FPL 2017a, FPL 2018f) (Figure 3-14). By letter dated June 21, 2016, FDEP authorized FPL to carry out the testing program in accordance with underground injection control Permit 293962-002-UC and Permit Modification 293962-003-UC/MM (FDEP 2013, FDEP 2016f, FDEP 2016g).

Meanwhile, in May 2017, Miami-Dade County approved FPL's remedial action plan for design and construction of the recovery well system (MDC 2017e). FPL began construction of the full-scale hypersaline groundwater recovery well system on June 19, 2017 (FPL 2017a). The recovery well system was completed on May 15, 2018, and it then became operational (FPL 2018h). Operation of the extraction well portion of the system is authorized under a South Florida Water Management District water use permit (Permit No. 13-06251-W), issued to FPL in February 2017 (SFWMD 2017a).

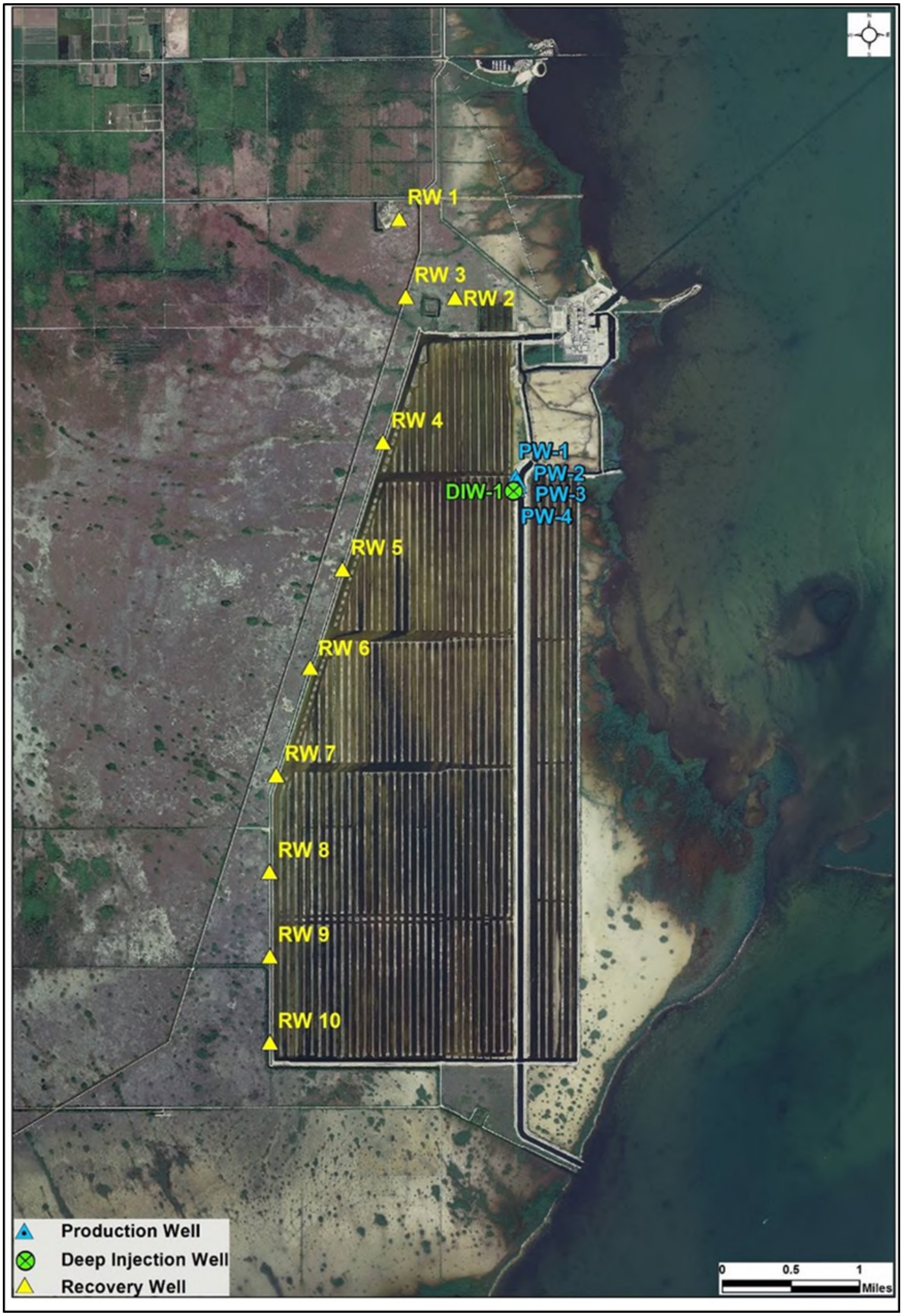
In July 2018, FDEP issued underground injection control Permit No. 0293962-004-UO/1I to FPL for operation of deep injection well DIW-1 for disposal of hypersaline groundwater (FDEP 2018d).

The installed full-scale hypersaline groundwater recovery well system consists of 10 hypersaline groundwater recovery (extraction) wells (i.e., numbered RW-1 through RW-10), generally located along the western edge of the CCS, and the Class 1 deep injection well (DIW-1) for disposal of the recovered hypersaline groundwater (Figure 3-14). Between September 2016 and May 2018, the testing and recovery well systems have extracted and disposed of approximately 8,285 million gallons (31.4 million m^3) of hypersaline groundwater, with the removal of 1.92 million tons (1.74 million metric tons) of salt from the Biscayne aquifer (FPL 2018h, 2018i). Section 3.5.2.3, "Groundwater Use," provides additional details on the recovery well system.

In its environmental report, FPL stated that groundwater modeling of the recovery well system operation indicates that the westward migration of the hypersaline plume will be stopped in

3 years of operation, with retraction of the hypersaline plume north and west of the CCS beginning in 5 years. FPL further projects that system operation will achieve retraction of the plume back to the FPL site boundary within 10 years, as required by the 2016 FDEP Consent Order with FDEP (FPL 2018f). FPL is required to conduct periodic continuous surface electromagnetic mapping surveys to delineate the extent of the hypersaline plume in order to measure the success of recovery and remediation efforts and report the results to FDEP. After 5 years of system operation, FPL must provide a report to FDEP that evaluates the effectiveness of the recovery well system in retracting the hypersaline plume to the L-31E Canal within 10 years. If FPL's report shows that the remediation efforts will not retract the hypersaline plume to the L-31E Canal within 10 years, FPL must develop and submit an alternate plan to FDEP for its approval (FDEP 2016e).

The Second Objective of the 2016 FDEP Consent Order focuses on the prevention of releases of groundwater from the CCS to surface waters connected to Biscayne Bay. To address these impacts, the 2016 FDEP Consent Order requires FPL to undertake specific environmental restoration projects at Turtle Point and at the Barge Turning Basin, as well as implement a nutrient management plan for the CCS, and to complete and report on the results of an inspection of the periphery of the CCS (FDEP 2016e). For status summaries of these projects, see the discussion in Section 3.5.1.4, "Adjacent Surface Water Quality and Cooling Canal System Operation," of this SEIS.



Source: Modified from FPL 2017b

Figure 3-14 Layout of Biscayne Aquifer Recovery Well System and Testing Wells

The Third Objective of the 2016 FDEP Consent Order requires mitigation for impacts related to the historic operation of the CCS, including but not limited to the hypersaline plume and its influence on the saltwater interface. Discrete mitigative actions specified in the 2016 FDEP Consent Order require FPL to convey specified tracks of FPL property to the South Florida Water Management District, if so requested, to facilitate the Comprehensive Everglades Restoration Plan; to make financial contributions to the State of Florida to support mitigation for saltwater intrusion; and to conduct water quality sampling in order to improve trend analysis in Biscayne Bay and Card Sound surface waters. Moreover, the 2016 FDEP Consent Order requires FPL to complete an analysis using the variable density, three-dimensional groundwater model developed in accordance with the requirements of the 2015 Consent Agreement to "allocate relative contributions of other entities or factors to the movement of the saltwater interface" (FDEP 2016e).

In June 2018, FPL presented the results of its modeling analysis to FDEP staff. In summary, FPL commissioned Tetra Tech, a consulting and engineering services company, to conduct an attribution sensitivity analysis using its existing variable density flow and salinity transport model (Tetra Tech 2018). Modeling runs were conducted to evaluate eight regional and environmental factors as compared to a base scenario in order to assess the effects of these factors on the location of the saltwater interface. These factors included: (1) operation of the Turkey Point CCS, (2) sea level rise, (3) changes in land use, (4) decadal-scale changes in climate in terms of precipitation recharge, (5) construction of drainage structures and changes to drainage practices, (6) construction and operation of controlled freshwater canals, (7) changes to groundwater use (changes to the operation and capacity of nearby wellfields), and (8) management and operation of mining practices west of the CCS.

FPL's modeling analysis indicates that operating the CCS with salinity in excess of 35 PSU is the single largest contributor to changes (movement) in the location of the saltwater interface, as measured by the areal extent of the saltwater interface. Changes were measured based on the average change in the area of salinity greater than 0.05 PSU west of the CCS over the thickness of the Biscayne aquifer. Other than CCS salinity, the modeling indicates that the next-most-influential locational factors are changes in climate, followed by canal operations over time (Tetra Tech 2018).

<u>Routine and Potential Inadvertent Releases of Radionuclides and Other Pollutants to Groundwater</u>

Nuclear power plants and other industrial facilities can impact groundwater quality by inadvertent releases of chemicals and petroleum products. Nuclear power plants can also impact groundwater quality through inadvertent releases of radionuclides, predominantly tritium, from spills and leaks from plant systems (NRC 2013a).

Nuclear power plants routinely release dilute concentrations of radionuclides, including tritium, in effluents (liquid and gaseous wastes) subject to compliance with NRC regulations. These authorized releases are closely monitored by the plant operator and reported to the NRC, with reports made available to the public on the NRC's Web site, in the form of annual radioactive effluent release reports. Similarly, potential impacts to the public and to the environment from plant radiological releases are evaluated and reported by NRC licensees in radiological environmental operating reports, which are also publicly available. Routine radiological effluents from Turkey Point Units 3 and 4, and FPL's associated effluent management and radiological environmental monitoring programs are described in Section 3.1.4.1, "Radioactive

Liquid Waste Management," Section 3.1.4.2, "Radioactive Gaseous Waste Management," and Section 3.1.4.5, "Radiological Environmental Monitoring Program," of this SEIS.

Normal operation of Turkey Point Units 3 and 4 results in the release to the CCS of monitored and permitted effluents containing tritium. Evaporation of CCS water results in tritium being released to the atmosphere as a component of the water vapor, while radioactive decay (with a half-life of approximately 12 years) limits the buildup of tritium concentrations over time in the waters of the CCS (NRC 2016a).

In 2017, based on the results of FPL's radiological environmental monitoring, the average tritium concentration in the waters of the CCS at site T08 (on the southern shore of the CCS, west of Grand Canal Bridge) was 10,391 pCi/L, with a maximum level of 24,483 pCi/L (FPL 2018k). Of the four supplemental surface water stations in FPL's REMP, the NRC staff assumes that this sampling location may be generally representative of ambient tritium levels in the CCS. For 2016, the average tritium concentration at this location was 6,126 pCi/L, with a maximum level of 17,456 pCi/L (FPL 2017d). For comparison, the EPA's primary drinking water standard for tritium is 20,000 pCi/L (40 CFR 141.16). Section 3.5.1.4, "Adjacent Surface Water Quality and Cooling Canal System Operation," further describes surface water quality in the CCS. As discussed there and as shown in Figure 3-13, "Extent of Tritium in the Deep Interval of the Biscayne Aquifer in the Vicinity of the Turkey Point Site, 2017," tritium concentrations decrease significantly with increasing distance from the site, to levels substantially below the EPA's primary drinking water standard.

Because the canals comprising the CCS are not lined, CCS water, which contains tritium, migrates into the groundwater of the underlying Biscayne aquifer (FPL 2018f, NRC 2016a). Within the highly permeable aquifer, diffusion is rapid and groundwater flow is relatively fast (FPL 2016h). Thus, tritium occurs in underlying groundwater in the Biscayne aquifer beneath the CCS as well as in adjacent areas of the aquifer that are beneath the Turkey Point, Units 3 and 4 plant complex.

An additional consideration for the presence and transport of tritium is that engineered backfill (crushed, compacted limestone) was used around the Turkey Point plant complex (nuclear island) with some structures extending to a depth of 45 feet (14 m) below land surface. On a more localized basis, subsurface structures may alter or impede the direction of groundwater flow (FPL 2016h). Further, it is likely that subsurface structures and the engineered backfill itself offer a preferential flow path for water containing tritium to reach the Biscayne aquifer beneath portions of the Turkey Point plant complex. Any inadvertent releases of liquids containing radioactive constituents from plant facilities and systems, spills, or leaks can also migrate to underlying groundwater.

Potentiometric surface (water table elevation) maps developed for the Turkey Point site and reviewed by the NRC staff show that groundwater flow across the main plant complex is tidally influenced in the shallow, intermediate, and deep monitored portions of the Biscayne aquifer. FPL states in its "Updated Final Safety Analysis Report, Turkey Point Units 3 & 4," that there is a rather consistent tidal influence on groundwater elevations across the Turkey Point site of 0.2 to 0.5 ft (0.06 to 0.15 m) maximum tidal fluctuation (FPL 2016h). Groundwater flow paths are further influenced by plant operations where operation of the circulating water system and associated intake and discharge canals generally produces radial flow across the plant site at shallow and intermediate depths during most tidal regimes. This appears to generally occur due to groundwater mounding on the discharge canal (west) side of the plant complex and a depressed water table surface on the intake (east side) of the plant. In contrast, during both low and high tides, groundwater flow in the deep portion of the Biscayne aquifer is more unidirectional, from south to north and from east to west (FPL 2018f).

FPL participates in the NEI 07-07, "Industry Ground Water Protection Initiative" (NEI 2007). The initiative identifies actions to improve management and response to instances in which the inadvertent (i.e., unplanned, uncontrolled, and unmonitored) release of radioactive substances may result in low but detectible levels of nuclear power plant-related radioactive materials in subsurface soils and water. The initiative identifies those actions necessary for the implementation of a timely and effective groundwater protection program along with acceptance criteria to demonstrate that the objectives have been met.

Since 2010, FPL has maintained a radiological environmental sampling and analysis program for Turkey Point that meets the recommendations of NEI 07-07. FPL performs groundwater monitoring at 28 onsite locations around Turkey Point Units 3 and 4 for potential inadvertent radioactive releases through groundwater pathways at the Turkey Point site in accordance with site procedures. FPL collects samples on at least a quarterly basis or more frequently if deemed necessary (FPL 2018f). Some of the groundwater monitoring locations have multiple (two or three) depths.

FPL states in its environmental report that it has detected tritium (a beta-emitting radioactive isotope of hydrogen) in groundwater. Since establishing its NEI 07-07 program, FPL has detected no Turkey Point-related gamma-emitting isotopes (FPL 2018f).

The NRC staff reviewed FPL's annual effluent release and radiological environmental operating reports for a 4-year period (2014 through 2017). The NRC staff found that FPL has documented seven actual or potential inadvertent releases to groundwater from Turkey Point, Units 3 and 4 operations. FPL completed appropriate corrective actions and entered the events and actions taken in the plant corrective action program, as appropriate. The list below summarizes these unplanned liquid releases:

- March 19, 2014, the Turkey Point Unit 3E demineralizer fill valve leaked a small amount of reactor coolant system (RCS) water (i.e., about 1 gallon (3.8 L)) on the roof of the auxiliary building, which was promptly cleaned up.
- August 24, 2014, the Turkey Point Unit 4 refueling water storage tank purification pump (4P209) drain line leaked 5 gallons (19 L) of reactor coolant system water to the ground. Corrective actions included increasing sampling of Turkey Point monitoring wells (i.e., PTN-MW-8S, PTN-MW-9S, and P-94-4) for gamma and tritium activity.
- September 23, 2014, the Unit 4 demineralizer resin fill valve and flange located on the roof of Turkey Point Unit 4 auxiliary building leaked about 50 gallons (190 L) of reactor coolant system water. Rainfall caused the leak to migrate to the storm drain system. Contamination included 0.132 Ci of cobalt-58 and 0.019 Ci of tritium. Corrective actions included monitoring the southeast storm drain as well as nearby monitoring wells (i.e., PTN-MW-8S and PTN-MW-9S).
- October 14, 2014, the Turkey Point Unit 4 refueling water storage tank valve 4-804 B leaked during the transfer of water from the refueling cavity. Approximately 1 L of reactor coolant system water was released to the ground before the leak was stopped. Corrective actions included monitoring nearby wells (i.e., PTN-MW-8S, PTN-MW-9S, and P-94-4) monthly for gamma activity and tritium.

- November 11, 2014, a pump casing leak occurred from the 4P209 Unit 4 refueling water storage tank purification pump. The total leak volume was not estimated but the pump leak was estimated to be approximately 60 drops per minute until the pump was shut down upon discovery of the leak. Corrective actions included increasing sampling of wells in the vicinity (i.e., PTN-MW-8S, PTN-MW-9S, and P-94-4) to monthly for gamma activity and tritium.
- July 26–September 15, 2015, a leak of intake cooling water contaminated with sodium-24 from the Turkey Point Unit 3 component cooling water (CCW) system occurred. Chemical inhibitors that contain sodium become activated when the CCW travels into a neutron field. The Turkey Point Unit 3 CCW heat exchanger, cooled by intake cooling water, developed a leak, and CCW, which contained activated sodium, leaked into the tube side of the heat exchanger. The release continued until the heat exchanger was plugged. The intake cooling water discharges into the mixing basin on the western side of plant, which is the same area used as discharge for the regular liquid radwaste tanks. The total release volume was approximately 4,828 gal (18,280 L). The total estimated quantity of sodium-24 released was 6.19 micro-Curies.
- October 5, 2017, the Unit 4D demineralizer resin fill valve and flange located on the roof of the Unit 4 auxiliary building showed signs of leakage to the roof. The southeast storm drain (in the likely flow path) was sampled and showed activity. The calculated dose from the estimated activity released was determined to be well below site Offsite Dose Calculation Manual limits.
- January 22, 2018, a spill occurred on the roof of the auxiliary building when radiation workers removed the protective cover on the Unit 4D demineralizer resin fill isolation valve. The spill volume was about 0.5 gal (1.9 L) and reached the storm drain system after initial response efforts were ineffective. Corrective actions included a complete replacement of the demineralizer rubber diaphragm valve with a new ball valve with stainless steel internals in order to eliminate valve leakage. The frequency of sampling of the surrounding monitoring wells (e.g., PTN-MW-8S) was increased to weekly, and no significant impact to groundwater was observed following the release (FPL 2013a, 2015a, 2015b, 2016i, 2016j, 2017d, 2017e, 2018j, 2018h, 2018k).

Table 3-5 summarizes the latest available radiological groundwater monitoring results that FPL has reported to the NRC for representative well locations, with the results compared to historical maximum observed concentrations. Monitoring well locations are depicted in Figure 3-15 below.

Table 3-5 Representative Groundwater and Storm Drain Monitoring Results for Tritium, Turkey Point Groundwater Protection Program, 2017 (in PicoCuries per Liter)

Well Number	First Quarter[(a,b)]	Second Quarter[(a,b)]	Third Quarter[(a,b)]	Fourth Quarter[(a,b)]	Previous 4-Year Maximum Concentration (Year-Quarter)
P-94-4	947	910	633	845	3,060 (2015-Q3)
PTN-MW-1S	<MDC	NA	<MDC	<MDC	80.5 (2014-Q3)
PTN-MW-1I	565	NA	345	NA	700 (2016-Q1)
PTN-MW-1D	1,940	NA	1,790	NA	2,310 (2015-Q3)
PTN-MW-4S	<MDC	<MDC	<MDC	<MDC	1,930 (2014-Q2)
PTN-MW-4I	2,840	2,780	2,900	2,490	3,570 (2016-Q1)

Well Number	First Quarter[a,b]	Second Quarter[a,b]	Third Quarter[a,b]	Fourth Quarter[a,b]	Previous 4-Year Maximum Concentration (Year-Quarter)
PTN-MW-4D	3,650	<MDC	<MDC	<MDC	3,840 (2015-Q4)
PTN-MW-7S	915	1,220	1,180	867	1,070 (2015-Q4)
PTN-MW-7I	1,030	1,330	1,750	1,430	2,400 (2015-Q3)
PTN-MW-7D	1,160	<MDC	<MDC	<MDC	2,370 (2014-Q1)
PTN-MW-8S	2,010	1,040	873	13,600	6,670 (2014-Q1)
PTN-MW-9S	334	853	702	798	773 (2015-Q4)
Northeast Storm Drain	<MDC	<MDC	455	9,990	1,140 (2016-Q3)
PTN-MW-11S	<MDC	709	623	425	804 (2014-Q3
PTN-MW-12S	855	723	1,080	963	1,140 (2016-Q1)
Southeast Storm Drain	<MDC	<MDC	1,570	13,000	10,600 (2016-Q3)
West Storm Drain	4,730	825	4,490	12,000	11,240 (2015-Q4)
CRF Storm Drain	No result	<MDC	<MDC	545	<MDC

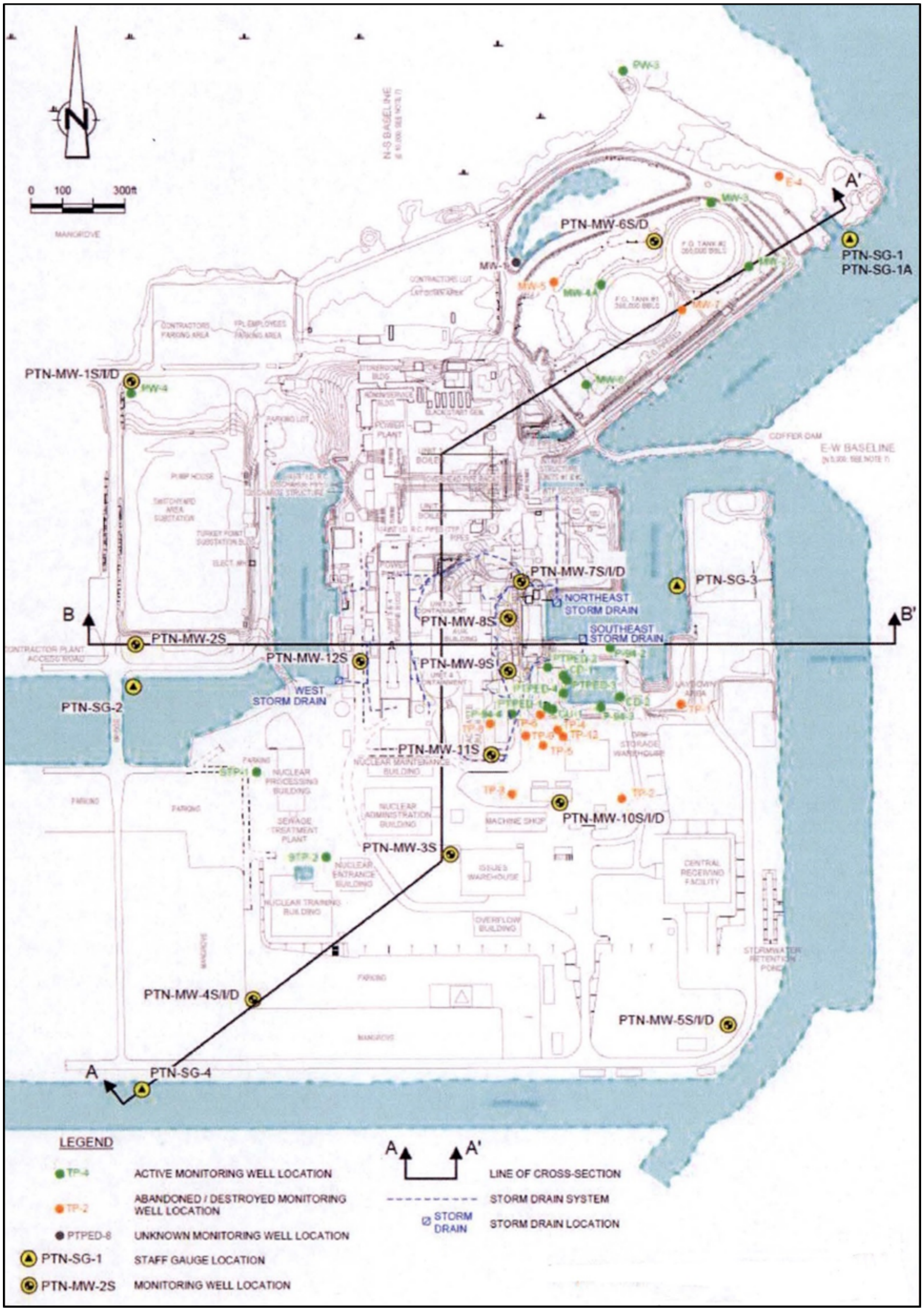
Notes: CRF=central receiving facility; MDC=minimum detectable concentration, value is less than the analytical MDC or less than 300 pCi/L tritium; NA=not applicable, as sampling not conducted or required for sampling period.

S, I, and D refer to approximate monitored depth below land surface: Shallow 20 feet (6 m), Intermediate 40 feet (12 m), and Deep 60 feet (18 m).

(a) FPL reports all results in picoCuries per liter (pCi/L).

(b) FPL generally collects quarterly samples in January, April, July, and October.

Source: FPL 2015b, FPL 2016j, FPL 2017d, FPL 2018k.



Source: Modified from FPL 2018k (Note: Cross-Sections Omitted)

Figure 3-15 Turkey Point Groundwater Protection Initiative Monitoring Well Locations

Based on these results, the NRC staff finds no apparent increasing trend in tritium concentration or a pattern indicating either a new inadvertent release or persistently high tritium concentrations that might indicate an ongoing inadvertent release from Turkey Point facilities to groundwater. In 2017, the highest observed level in Turkey Point groundwater was 13,600 pCi/L at well PTN-MW-8S. This location is near the Turkey Point Unit 3 refueling water storage tank, shown in Figure 3-15. Elevated tritium levels were also detected in storm drain locations, which likely represents tritium concentrations in the CCS during periods when storm drain outfalls are occasionally below the tidal mark in the canal system (FPL 2018k). Nevertheless, all results are less than the limits prescribed by FPL's Offsite Dose Calculation Manual (FPL 2013a) for the plant, which for tritium is 30,000 pCi/L, as groundwater at the site is not designated for potable use.

At the time of the NRC's onsite environmental audit in 2018 for the subsequent license renewal, FPL was preparing a site conceptual model as part of an effort to identify and characterize groundwater flow and the occurrence and migration of tritium at the FPL property, including locations such as: Turkey Point Units 1, 2, and 5, the diesel storage tank area, and portions of the intake and discharge canals. Other objectives of this effort include evaluation of potential human, ecological, or environmental receptors of tritium that might have been released to the groundwater and development of recommendations for additional investigations and long-term monitoring (FPL 2018h).

With respect to unplanned, non-radiological releases, FPL reported no accidental spills or similar releases of nonradioactive substances, including petroleum products, at Turkey Point over the past 5 years, nor any associated notices of violation issued to FPL for such releases (FPL 2018f, FPL 2018h). The NRC staff's review of available information and regulatory databases found no documented instances of accidental spills of chemical or petroleum products to groundwater that resulted in a regulatory action over the last 5 years.

3.5.2.3 Groundwater Use

Section 2.2.2 of NUREG–1437, Supplement 5 describes water use and sanitary wastewater management for Turkey Point operations (NRC 2002c). As indicated in that section, water for Turkey Point process makeup (e.g., primarily demineralizer water makeup), potable water, and fire protection water uses was obtained from the Miami-Dade Water and Sewer Department (MDWSD). Sanitary wastewater was being processed in an onsite treatment plant and discharged to groundwater (Biscayne aquifer) through an onsite injection well (i.e., IW-1). That section further states that no surface water or groundwater was being withdrawn for use as makeup water for the CCS at that time. The NRC staff incorporates the information in NUREG–1437, Supplement 5, Section 2.2.2 (NRC 2002c: 2-5, 2-17, 2-18), here by reference. The following discussion presents new information regarding groundwater use for Turkey Point operations, beyond the information in NUREG-1437, Supplement 5.

In southeast Florida and in Miami-Dade County where Turkey Point is located, groundwater aquifers are used both as a water supply and as a reservoir for wastewater disposal via deep well injection. Nearly all of the potable water supplied by the MDWSD to southern Miami-Dade County comes from the Biscayne aquifer (MDC 2018b, NRC 2016a) (Section 3.5.2.2). The exception is water from the County's Alexander Orr, Jr. water treatment plant, which mixes some brackish groundwater from the Upper Floridan aquifer with Biscayne aquifer groundwater (NRC 2016a).

In 2015, groundwater withdrawals in Miami-Dade County totaled 409.2 mgd (1.55 million m^3/day) from freshwater sources and 40.5 mgd (153,300 m^3/day) from saline sources. Withdrawals for public water supply comprised the largest use including 338.9 mgd (1.28 million m^3/day) from freshwater sources and 13.0 mgd (49,200 m^3/day) from saline sources. Withdrawals for power generation included 1.28 mgd (4,850 m^3/day) from freshwater sources and 27.5 mgd (104,000 m^3/day) from saline sources (USGS 2018a).

The MDWSD continues to supply potable water to Turkey Point for drinking and fire protection water uses. Sanitary wastewater disposal continues to be accomplished through an FDEP permitted injection well, as well as by septic tanks (FPL 2018f).

FPL completed installation of a replacement water treatment plant in 2017, which is designed to supply pure/ultrapure (demineralized) water for Turkey Point uses. The new system can treat either municipally supplied water (i.e., from the MDWSD) or groundwater from the Upper Floridan aquifer. The use of groundwater is intended to reduce FPL's use of MDWSD water by 1 mgd (3,800 m^3/day) and associated costs. Wastewater from the new treatment plant is discharged to the CCS (FPL 2018f). Section 3.10.4.3, "Public Water Supply," of this SEIS describes the MDWSD public water supply system, and Section 3.1.5, "Nonradioactive Waste Management Systems," describes nonradioactive waste management systems that support Turkey Point Units 3 and 4 operations.

Currently, FPL uses onsite groundwater withdrawn from the Biscayne and Upper Floridan aquifers for a variety of applications in support of Turkey Point operations, as well as for other activities conducted on the Turkey Point site unrelated to Turkey Point. These principal uses include withdrawals from the Upper Floridan aquifer for freshening of the CCS, operation of a recovery well system and associated underground injection well to extract and dispose of hypersaline groundwater from the Biscayne aquifer, operation of Biscayne aquifer marine wells to supplement CCS freshening, and operation of Upper Floridan Aquifer saline production wells for various onsite uses.

Table 3-6 summarizes FPL's reported groundwater withdrawals associated with these well systems for the period from January 2015 through June 2018. In 2017, FPL's groundwater withdrawals from the Biscayne aquifer totaled about 8,928.8 mgy (33.8 million m^3/year), or approximately 24.5 mgd (92,700 m^3/day). For the Upper Floridan aquifer, withdrawals totaled 7,137.2 mgy (27.0 million m^3/year), or approximately 19.6 mgd (74,200 m^3/day).

The nature of these withdrawals and the applicable regulatory requirements governing them are further described below.

Table 3-6 Groundwater Withdrawals at the Turkey Point Site

	Withdrawals (mgy)			
Year	**UFA Saline Well System (PW-1, PW-3, PW-4)**	**Biscayne Aquifer Marine Well System (PW-1, SW-1, and SW-2)**	**UFA Freshening Well System (F-1, F-3, F-4, F-5, F-6)**	**Biscayne Aquifer Recovery Well System (RW-1–RW-10)**
2015	3,339.6	6,065	0.0	0.0
2016	2,237.2	0.0	1,051.6	879.8[a]
2017	2,361.9	4,031.7	4,775.3	4,951.1[a]
2018[b]	1,329.4[b]	0.0	2,106.4[b]	1,994.2[c]

Key: mgy=million gallons per year; mgd=million gallons per day; UFA=Upper Floridan aquifer.

Note: Some reported values have been rounded. To convert million gallons per year (mgy) to million cubic meters (m^3), divide by 264.2. To convert million gallons per day (mgd) to cubic feet per second, multiply by 1.547; for m^3, multiply by 3785.4.

[a] Withdrawals associated with hypersaline extraction and deep well injection program, using test extraction wells PW-1 through PW-4.

[b] Partial-year withdrawal data for the period from January through June 2018.

[c] Withdrawals associated with hypersaline extraction and deep well injection program, using test extraction wells PW-1 through PW-4, with the addition of recovery well system wells RW-1 through RW-10, which began operations in May 2018.

Source: Compiled from FPL 2018h, FPL 2018l.

Turkey Point Site Water Supply Systems

Water for cooling and process makeup water for Turkey Point Unit 5 is obtained from Upper Floridan aquifer "saline" production wells (i.e., wells PW-1, PW-3, and PW-4), as depicted in Figure 3-16. These wells were commissioned in February 2007 (FPL 2018f). The wells are authorized under FPL's modified site certification and associated conditions of certification for the Turkey Point site. The wells range in depth from 1,242 to 1,247 feet (378.6 to 380.1 m), each with a pump capacity of 5,000 gpm (18,900 L/min) (State of Florida Siting Board 2016, FDEP 2016b). The 2016 Conditions of Certification specifically authorizes the withdrawal of 14.06 mgd (53,200 m^3/day) of groundwater from the upper production zones of the Upper Floridan aquifer for cooling water for Unit 5 and process water for Units 1, 2, 3, 4, and 5 (FDEP 2016b). In March 2018, FPL began using approximately 1.1 mgd (4,200 m^3/day) of groundwater from the Upper Floridan aquifer saline wells as makeup water to the pure/ultrapure (demineralized) makeup water treatment system for Turkey Point Units 3 and 4 primary and secondary system uses. This usage replaces approximately 0.65 mgd (2,500 m^3/day) of potable water that had been supplied by the MDWSD from the Newton Wellfield (FPL 2018h).

FPL completed installation of three marine wells in the 2015 timeframe (i.e., wells PW-1 (test), SW-1, SW-2) to provide water for salinity reduction in the CCS (i.e., CCS freshening) (FPL 2018f, FPL 2018m). These wells are located on the Turkey Point peninsula and withdraw from the upper portion of the Biscayne aquifer (Figure 3-16). Consequently, the marine wells withdraw saltwater (Golder Associates 2016). Before being converted to a production well in late 2014 and early 2015, PW-1 was originally installed in 2009 as a 30-inch (76-cm) diameter test well for evaluation of a radial collector well system for proposed new reactors, Turkey Point Units 6 and 7 (FPL 2018m). Well PW-1 has a total depth of 46 feet (14 m), with an open borehole from 22 to 46 feet (6.7 to 14.0 m) below the casing (HDR Engineering 2009). It is equipped with a 7,000-gpm (26,500-L/min) pump (FPL 2018m). Marine wells SW-1 and SW-2 are 36-inches (91-cm) in diameter. The two wells are completed to total depths of 56 and 55 feet (17.1 and 16.8 m), respectively, with the lower 30 feet (9.1 m) of each well terminating in an open borehole. Each of these wells has a 12,500-gpm (47,300 L/min) rated capacity pump (FPL 2018m). Together, the three wells have a combined production capacity of approximately 45 mgd (170,300 m^3/day) (FPL 2018f). Notwithstanding this nominal production capacity, the total water volume that can be withdrawn and conveyed to the intake canal area is limited by considerations associated with measurement of the ultimate heat sink temperature and compliance with the technical specifications in the Turkey Point, Units 3 and 4 operating licenses. Specifically, the total flow must be less than or equal to 23,400 gpm (88,600 L/min) when only one Turkey Point unit is operating and 41,600 gpm (157,500 L/min) when both Units 3 and 4 are operating (FPL 2018m).

Operation of the marine wells does not require a groundwater consumptive use permit from the South Florida Water Management District because saltwater is not regulated by the State (FPL 2018f). In general, users of seawater, or reclaimed water, are not required to obtain water use permits (SFWMD 2015). The water withdrawn from the marine wells has an average salinity of around 36 PSU (FPL 2017b). Historically, the salinity of marine well water has ranged from about 34 PSU to nearly 40 PSU with chloride concentrations ranging from approximately 20,000 to 23,000 mg/L (FPL 2016f). FPL has used the wells during periods of peak CCS salinity to moderate salinity rise (FPL 2018f). As stipulated under the 2015 Consent Agreement (MDC 2015a) between FPL and Miami-Dade County, the marine wells may only be used to lower salinity in the CCS under “extraordinary circumstances.” As a result, FPL reports that the wells are used in response to extraordinary circumstances or upset recovery to support regulatory requirements (FPL 2018f, FPL 2018m).

In 2016, FPL installed five additional production wells (i.e., wells F-1, F-3, F-4, F-5, and F-6) to provide water from the Upper Floridan aquifer for use in the CCS (Figure 3-16). As previously described, the freshening wells are authorized under FPL’s modified site certification and associated conditions of certification for the Turkey Point site, which permit a total withdrawal of 14 mgd (53,000 m^3/day) for salinity reduction (State of Florida Siting Board 2016, FDEP 2016b). The wells are artesian in nature (i.e., require no pumping) and flow is conveyed directly into the CCS. The 20-inch (51-cm) diameter wells range in depth from 1,000 to 1,250 feet (304.8 to 381 m) (FDEP 2016b, FPL 2018f). Each well is equipped with a 2,500-gpm (9,460 L/min) capacity pump (FDEP 2016b).

As described in Section 3.5.2.2, “Groundwater Quality,” in May 2018, FPL completed and began operation of a recovery well system to meet the groundwater remediation objectives specified in the 2015 Consent Agreement (MDC 2015a) with Miami-Dade County and the 2016 Consent Order with the Florida Department of Environmental Protection (FDEP 2016e). The system consists of 10 hypersaline groundwater recovery (extraction) wells (designated RW-1 through RW-10) completed in the Biscayne aquifer and one deep injection well (DIW-1) for disposal of hypersaline groundwater (Figure 3-14). These wells replaced the four demonstration wells (designated PW-1 through PW-4) that FPL used for hypersaline groundwater recovery testing from September 2016 through April 2018.

The 24-inch (61-cm) recovery wells are each drilled to a total depth of 110 feet (33.5 m) and are cased to a depth of 70 feet (21 m) below land surface. Each recovery well is equipped with a 1,042-gpm (3,900-L/min) electric pump, giving the well system a combined extraction capacity of 15 mgd (56,700 m^3/day) (SFWMD 2017a). Each extraction well pump discharge is fitted with backflow prevention, a magnetic flow meter, a pressure transducer, a pump discharge pressure transmitter, sample tap, and an air release valve. Each well is also equipped with a water quality monitoring station. The wells are operated with programmable logic controllers and variable frequency driven well motor pump sets, and they are controlled and continuously monitored by remote secure radio communication telemetry to a main control building located near the deep injection well. The wells are connected in parallel by 14-inch (36-cm) diameter piping which runs to a 28-inch (71-cm) header that conveys the extracted hypersaline groundwater to deep injection well DIW-1. A total of about 9.5 mi (15 km) of pressure-rated piping is used in the conveyance system (FPL 2018h). Recovery well operations are permitted under a South Florida Water Management District-issued individual water use permit (Permit No. 13-06251-W) (FPL 2018f, SFWMD 2017a). The permit specifies a maximum monthly withdrawal allocation of 465 million gallons (1.76 million m^3) (SFWMD 2017a).

The deep injection well DIW-1 discharges extracted hypersaline water to the Boulder Zone at a depth of approximately 3,200 feet (975 m). DIW-1 is constructed of concentric piping (casing strings) ranging from 64-inch (163-cm) diameter steel casing in the upper interval to 33 feet (10 m) below land surface, 24-inch (61-cm) diameter steel casing to 2,985 feet (910 m) below land surface, and followed by an 18-inch (46-cm) diameter liner to a depth of 2,975 feet (907 m) below land surface. The liner tubing is fiberglass reinforced pipe with a fluid filled annulus. The total depth of the well borehole is 3,230 feet (984.5 m) below land surface (FDEP 2013).

The deep injection well DIW-1 is paired with a dual-zone monitoring well (DZMW-1), which is completed in the Floridan aquifer with upper and lower monitoring zones at 1,450 to 1,490 ft (442 to 454 m) below land surface and 1,860 to 1,905 feet (567 to 581 m) below land surface (FDEP 2013). Operation of DIW-1 is authorized under FDEP Permit No. 293962-002-UC (FPL 2013, FDEP 2018d). The maximum permitted injection rate for DIW-1 is 10,826 gpm (41,000 L/min), or 15.59 mgd (59,000 m^3/day), and the well is required to be periodically tested for injectate confinement (FDEP 2013).

The Boulder Zone is located in the Lower Floridan aquifer and is overlain by a confining layer that retards upward migration of wastewater (FPL 2018f). The FDEP permits FPL and others to discharge treated sewage and other wastes through injection wells into the Boulder Zone. All Boulder Zone underground injection wells must be permitted and monitored by the FDEP underground injection control program. As an example, the Miami-Dade Water and Sewer Department’s South District Wastewater Treatment Plant located approximately 9 mi (14 km) north of the Turkey Point site disposes of municipal wastewater through as many as 13 deep injection wells into the Boulder Zone (NRC 2016a).

<u>Other Water Supply Wells</u>

While the Biscayne aquifer is the principal source of potable water supplied by the Miami-Dade Water and Sewer Department, the Biscayne aquifer is not a source of potable water in the vicinity of the Turkey Point site, as discussed in Section 3.5.2.2, “Groundwater Quality.” Other than FPL-owned water wells, described above, there are no potable water wells (drawing from either the Biscayne or Floridan aquifer systems) within the Turkey Point site boundary.

There are no registered groundwater supply wells within a 2-m (3.2-km) band of the Turkey Point site boundary (FPL 2018f). Relative to the Turkey Point site, the nearest mapped water supply wells are located about 5 mi (8 km) west of the western boundary of the CCS and are used to support mining operations (FDOH 2018a).

As for public water supply sources, the nearest wells are located about 6 mi (10 km) from the northwest corner of the CCS and approximately 7 mi (11 km) from the center of the Turkey Point plant complex. These wells are located at Newton Field (i.e., the Newton Wellfield) and are operated by Miami-Dade County (see Figure 3-12) (FDOH 2018a, MDC 2006, MDC 2018c, NRC 2016a).

Potable water supply for the Florida Keys comes from Biscayne aquifer wells and an Upper Floridan aquifer well located west of Florida City at the Florida Keys Aqueduct Authority's J. Robert Dean Water Treatment Plant. These facilities are located approximately 9.5 mi (15 km) west, northwest of the western boundary of the CCS (FDOH 2018a, MDC 2006, MDC 2018c, NRC 2016a).

Source: Modified from FPL 2017b

Figure 3-16 Location of Groundwater Production Wells on the Turkey Point Site

3.6 Terrestrial Resources

This section describes the terrestrial resources of the affected environment, including the surrounding ecoregion. The terrestrial resources include plant and animal species, vegetative communities, and important habitats present on or in the vicinity of the Turkey Point site. This section also describes important species and habitats that potentially may be present on or near the Turkey Point site. Plants and animals federally listed as endangered or threatened are discussed in Section 3.8, "Special Status Species and Habitats."

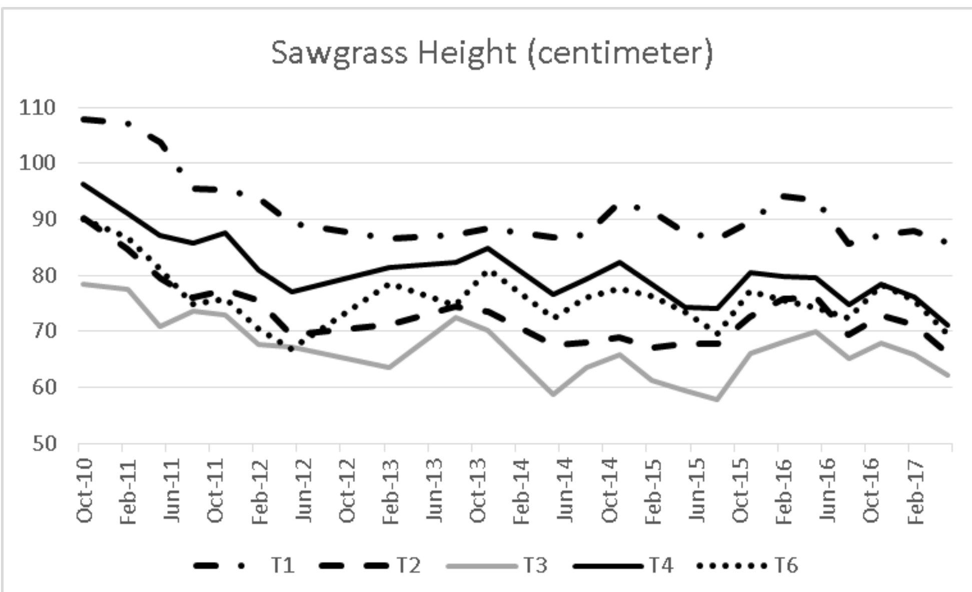
3.6.1 Vegetative Communities

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. The NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a), Section 2.4.1.1 and Tables 2-2 and 2-3 describe the physiographic province, the general ecology of the Turkey Point site, and the land cover of various habitats within the vicinity of Turkey Point. Section 2.4.1.1 of NUREG-2176 (NRC 2016a) also summarizes the results of vegetative surveys of the Turkey Point site through 2011. The NRC staff incorporates the above information from NUREG–2176, Section 2.4.1.1 and Tables 2-2 and 2-3 into this SEIS by reference (NRC 2016a: 2-76 to 2-77; Tables 2-2 and 2-3).

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

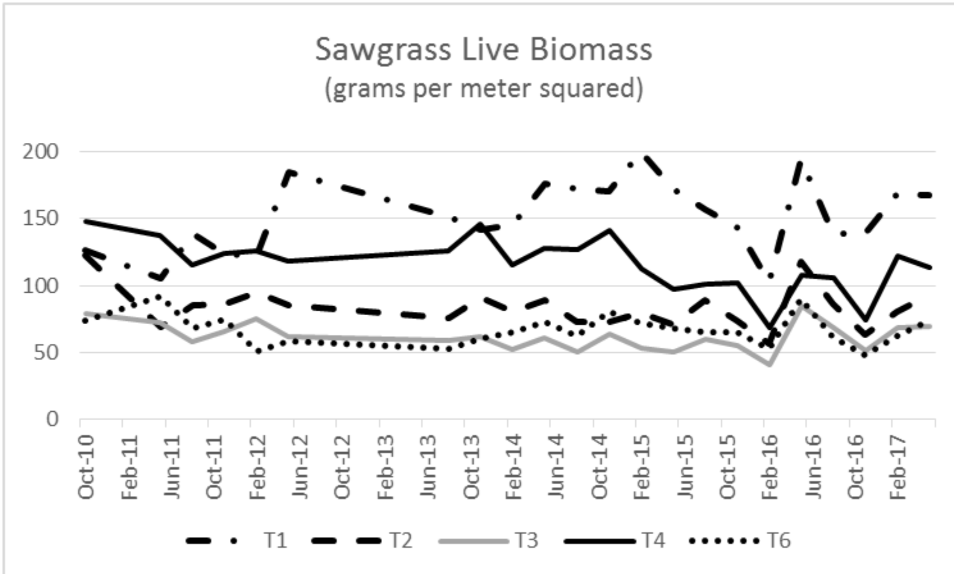
The most common freshwater wetlands near the CCS are sawgrass (*Cladium jamaicense*) marshes. Sawgrass marshes are flooded for the majority of the year, and the relative abundance of sawgrass compared to other species tends to be positively correlated with both the length of the hydroperiod (or time in which the area is flooded) as well as the depth of the water during the hydroperiod (UF undated, Foti et al. 2012). Vegetative species diversity is generally low within sawgrass marshes for a few reasons: (1) sawgrass plants can grow so densely that few other species can establish in the limited space, and (2) sawgrass marshes thrive in harsh physiological conditions, including flooding and deep water, that few plants can tolerate (Brown et al. 2006). After sawgrass, the next most common plant species in the freshwater wetlands near the CCS is the spikerush (*Eleocharis cellulose*). Species diversity generally ranges from one to three plant species per plot (FPL 2012a, FPL 2014b, FPL 2016a, FPL 2016b, FPL 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, FPL 2014b, FPL 2016a, FPL 2016b, FPL 2017a).

Using FPL's data from 2011 through 2017, the NRC staff plotted the height of sawgrass plants and live biomass within the five freshwater marsh transects (see Figure 3-17 and Figure 3-18). Sawgrass height tended to be highest during fall and winter, and slightly shorter in spring and summer. Average sawgrass 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 and November 2016 and then increased by February 2017 and remained at a similar or higher level in May 2017. The seasonal and annual changes in sawgrass height and live biomass were generally similar between the reference transect (T6) chosen for being farther from the CCS, and the transects closer to the CCS (T1-4). The survey shows that wetlands at different distances from the CCS exhibit similar growth trends. These patterns suggest that landscape-scale environmental factors, such as the length of the hydroperiod or overall water depth, have a greater effect on changes in live biomass and sawgrass height than proximity to 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.



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

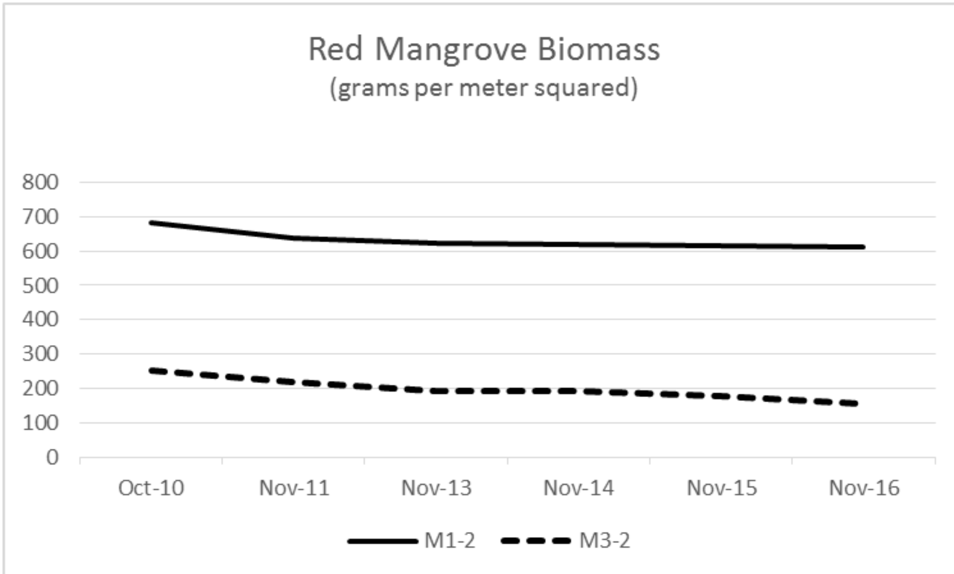
Figure 3-17 Average Height of Sawgrass Blades Within Freshwater Marsh Transects from October 2011 through February 2017



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

Figure 3-18 Live Sawgrass Biomass Within Freshwater Marsh Transects from October 2011 through February 2017

In scrub mangrove plots at Turkey Point, 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 Turkey Point 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 3-19). In its 2017 annual Turkey Point monitoring report, FPL (FPL 2017a) noted that although biomass has decreased in mangrove plots M1-2 and M3-2, percent cover and height have remained relatively consistent in these plots. FPL also stated its intention to closely monitor these two decreasing mangrove plots in the future.



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

Figure 3-19 Live Biomass Within Two Red Mangrove Plots (M1-2 and M3-2) from October 2011 through February 2017

In 2017, the Southwest Florida Water Management District (SWFMD) issued Permit No. 13-06251-W allowing FPL to recover and extract the hypersaline water within and around the CCS (SFWMD 2017a). This water extraction, called dewatering, has the potential to impact wetland growth because it removes water from an ecosystem where greater water depth and longer hydroperiods are directly and positively related to vegetative growth and species composition (UF undated, Foti et al. 2012). As part of its permit process, the SWFMD modeled drought conditions (up to a 1-in-10-year drought) and determined that a maximum drawdown of less than 0.3 feet (9.1 cm) of water could occur west and north of the CCS under drought conditions during operation of the wells (SWFMD 2017a). This maximum drawdown limit also applies to onsite as well as offsite wetlands that are west of the CCS. The L-31E Canal would provide some buffering of the drawdown area due to canal water storage. In conclusion, the SWFMD determined that while the authorized withdrawal would impact wetlands, the impacts to onsite and offsite wetlands would be minimal (SWFMD 2017a).

3.6.2 Wildlife

Southern Florida lies at the southern tip of a temperate landmass, and its subtropical climate supports a wide variety of ecosystems and wildlife, including approximately 350 bird, 50 reptile, 40 mammal, and 15 amphibian species (NPS 2015b). Several tropical species inhabit Florida's mangroves and warm waters, while temperate species migrate south from other areas in the United States. Furthermore, productive wetlands provide a source of refuge and foraging grounds for numerous wildlife and bird species. Section 2.4.1.1 of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) describes wildlife and avian studies conducted at and near Turkey Point in 1972 and from 2005 through 2009. The NRC staff incorporates the above information into this SEIS by reference (NRC 2016a: pages 2-79 to 2-80).

On May 23, 2016, FPL conducted bird and reptile surveys within the vicinity of the Turtle Point remnant canal and Barge-Turning Basin water quality improvement projects. FPL observed one reptile species, the American crocodile (*Crocodylus acutus*), and 6 bird species: common nighthawk (*Chordeiles minor*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), anhinga (*Anhinga anhinga*), mockingbird (Mimus polyglottis), and rusty blackbird (*Euphagus carolinus*) (FPL 2016c). The NRC staff (NRC 2016a) previously identified these species as occurring at the Turkey Point site in the EIS for the Turkey Point Units 6 and 7 combined licenses.

From December 5–7, 2016, FPL conducted its CCS characterization study (EAI 2017), which primarily focused on sampling the CCS for fish and invertebrates. FPL also recorded any observations of birds near and within the vicinity of the CCS. In total, FPL documented 13 bird species, many of which used the CCS as a foraging ground for fish during the study. Observed birds included snowy egrets (*Egretta thula*), little blue herons (*Egretta caerulea*), tricolored herons (*Egretta tricolor*), reddish egrets (*Egretta rufescens*), great egrets (*Ardea alba*), roseate spoonbills (*Platalea ajaja*), wood storks (*Mycteria americana*), American white pelicans (*Pelecanus erythrorhynchos*), a yellow-crowned night heron (*Nyctanassa violacea*), a double-crested cormorant, an American avocet (*Recurvirostra americana*), great blue herons (*Ardea herodias*), belted kingfishers (*Megaceryle alcyon*), and ospreys (*Pandion haliaetus*).

The NRC staff also reviewed the Florida Fish and Wildlife Conservation Commission's (FFWCC) Florida Shorebird Database, which is a database of shorebird and seabird occurrences in Florida (FFWCC 2018). The Florida Shorebird Database indicated that a breeding colony of least terns (*Sterna antillarum*), which are listed by the State of Florida as a threatened species in the State, occurs at Turkey Point. Least terns are discussed in further detail in Section 3.7.3.1, "State-Listed Species."

3.6.3 Important Species and Habitats

3.6.3.1 State-Listed Species

In accordance with Chapter 68A-27 of the Florida Administrative Code (FAC), the Florida Fish and Wildlife Conservation Commission oversees the State's Threatened and Endangered Species Conservation Program. This chapter of the FAC gives the FFWCC the authority to list species as State-threatened or endangered; to issue regulations necessary and advisable to provide for conservation of such species; and to prohibit anyone from taking a species, which includes activities that would harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct.

Section 2.4.1.3 and Tables 2-14 and 2-15 of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) describe the State-listed threatened or endangered species that may occur in Miami-Dade County, not including those species that are also Federally listed. This information is incorporated here by reference (NRC 2016a: pages 2-97 to 2-109). The NRC staff reviewed the list of State threatened and endangered species within Miami-Dade County that are not Federally listed (FNAI 2018) and determined that Tables 2-14 and 2-15 in NUREG–2176 included all listed species as of August 2018, except for the following, which the NRC staff here adds to the list of State-listed threatened or endangered species identified in NUREG-2176:

- sea rosemary (*Heliotropium gnaphalodes*), State-listed as endangered
- Florida shrub thoroughwort (*Koanophyllon villosum*), State-listed as endangered
- Florida Keys ladies'-tresses (*Mesadenus lucayanus*), State-listed as endangered
- star-scale fern (*Pleopeltis astrolepis*), State-listed as endangered

- pineland spurge (*Poinsettia pinetorum*), State-listed as endangered
- mucha-gente (*Xylosma buxifolia*), State-listed as endangered

In addition, Simpson's prickly apple (*Harrisia simpsonii*), Fahkahatchee ladies'-tresses (*Sacoila lanceolata var. Paludicola*), and Florida black bear (*Ursus americanus floridanus*) were included in NUREG–2176, Tables 2-14 and 2-15. However, these species are not listed as State endangered or threatened as of August 2018 (FNAI 2018). Florida pine snake (*Pituophis melanoleucus mugitus*), Florida burrowing owl (*Athene cunicularia Floridana*), little blue heron, reddish egret, tricolored heron, American oystercatcher (*Haematopus palliates*), roseate spoonbill, and black skimmer (*Rynchops niger*) were identified as species of special concern in Table 2-15 but are listed as State threatened as of August 2018. The change in classification of these species therefore modifies the Tables of State-listed threatened or endangered species identified in NUREG-2176.

Tables 2-14 and 2-15 in the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) also describe whether the species has been observed at the Turkey Point site. Since the NRC staff published NUREG–2176, FPL has conducted two new ecological surveys (FPL 2016c, EAI 2017) as described in Section 3.7.3, "Aquatic Resources on the Turkey Point Site." In its May 23, 2016, survey, FPL (2016c) did not observe any State-listed species other than the American crocodile, which is State- and federally listed as threatened. The crocodile is addressed in Section 3.8.1.1, "Species and Habitats under U.S. Fish and Wildlife Jurisdiction," of this SEIS. Ecological Associates, Inc., (EAI 2017) observed five State-listed species in the 2016 CCS Characterization Study, including wood storks (also federally listed), little blue herons (*Egretta caerulea*), tricolored herons, reddish egrets, and roseate spoonbills. These five species had been previously observed at the Turkey Point site, as shown in NUREG–2176, Table 2-15.

A colony of least terns nest on berms within the CCS (FPL 2018f). The Florida Fish and Wildlife Conservation Commission's shorebird monitoring program suggests that this colony at the Turkey Point CCS is one of the largest ground-nesting colonies of least terns on the eastern coast of Florida between Key West and Melbourne and that this colony also maintains high rates of nesting success (FFWCC 2016). To minimize disturbances to this nesting colony, FPL installed warning signs surrounding the berms to alert site personnel that least terns are in the vicinity. FPL also limits boat traffic near the colony during nesting season. FPL expects to continue these activities during the subsequent license renewal period of extended operation (FPL 2018g).

3.6.3.2 Migratory Birds

The U.S. Fish and Wildlife Service administers the Migratory Bird Treaty Act (MBTA), which prohibits anyone from taking native migratory birds or their eggs, feathers, or nests. Regulations under the Migratory Bird Treaty Act define "take" as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to" carry out these activities (Title 50, "Wildlife and Fisheries," of the *Code of Federal Regulations* (50 CFR) 10.12, "Definitions"). The act protects a total of 1,007 migratory bird species (75 FR 9282). The FWS (FWS 2018a) stated that 35 migratory birds of concern may occur on or near the Turkey Point site. Of those 35 migratory bird species, FPL (FPL 2018g) identified 11 species that have been observed onsite at Turkey Point. FPL (FPL 2018g) also noted that 23 additional bird species protected under the MBTA have been observed onsite, although they were not included in FWS's (FWS 2018a) database. The NRC staff notes that FPL has not implemented a formal monitoring or survey program for migratory birds. Nonetheless, Table 3-7 describes the birds protected under the MBTA that are most likely to occur at the Turkey Point site. As indicated below, migratory birds use the Turkey Point site for resting, foraging, and breeding.

The FWS also administers the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. 668 et seq.), which prohibits anyone from taking bald eagles (*Haliaeetus leucocephalus*) or golden eagles (*Aquila chrysaetos*), including their nests or eggs, without a permit issued by the FWS. The FWS (FWS 2018a) determined that bald eagles may occur and breed within the vicinity of the Turkey Point site throughout the year. FPL (FPL 2018g) has observed bald eagles using the Turkey Point site for resting, although the species is rarely observed onsite.

Table 3-7 Migratory Birds Protected under the Migratory Bird Treaty Act That Are Most Likely to Occur at Turkey Point

Scientific Name	Common Name	Frequency of Onsite Observations	Onsite Habitat Use
Anhinga	anhinga	occasionally	resting, foraging
Ardea alba	great egret	frequently	resting, foraging
Ardea herodias	great blue heron	frequently	resting, foraging
Bubo virginianus	great horned owl	rarely	resting, foraging, breeding
Bubulcus ibis	cattle egret	frequently	resting, foraging
Butorides virescens	green heron	frequently	resting, foraging, breeding
Charadrius vociferus	killdeer	frequently	resting, foraging, breeding
Chordeiles minor	common nighthawk	frequently	resting, foraging, breeding
Circus hudsonius	northern harrier	frequently	resting, foraging
Crotophaga ani	smooth-billed ani	rarely	resting, foraging
Egretta caerulea	little blue heron	frequently	resting, foraging
Egretta rufescens	reddish egret	frequently	resting, foraging
Egretta thula	snowy egret	frequently	resting, foraging
Egretta tricolor	tri-colored heron	frequently	resting, foraging
Elanoides forticatus	swallow-tailed kite	rarely	resting, foraging
Empidonax sp.	flycatcher	occasionally	resting, foraging
Eudocimus albus	white ibis	frequently	resting, foraging
Falco peregrinus	peregrine falcon	occasionally	resting, foraging
Gavia immer	common loon	rarely	unknown
Haliaeetus leucocephalus	bald eagle	rarely	foraging
Megaceryle alcyon	belted kingfisher	frequently	resting, foraging
Megascops asio	screen owl	occasionally	resting, foraging, breeding
Melanerpes carolinus	red bellied woodpecker	frequently	resting, foraging, breeding
Mycteria americana	woodstork	occasionally	resting, foraging
Pandion haliaetus	osprey	frequently	resting, foraging
Patagioenas leucocephala	white-crowned pigeon	frequently	resting, foraging
Pelecanus erythrorhynchos	American white pelican	frequently	resting, foraging
Pelecanus occidentalis	brown pelican	occasionally	resting, foraging
Phalacrocorax auritus	double-crested cormorant	frequently	resting, foraging
Platalea ajaja	roseate spoonbill	frequently	resting, foraging

Scientific Name	Common Name	Frequency of Onsite Observations	Onsite Habitat Use
Sterna antillarum	least tern	frequently	resting, foraging, breeding
Thalasseus maximus	royal tern	frequently	resting, foraging
Tringa flavipes	lesser yellowlegs	occasionally	resting, foraging
Tyrannus dominicensis	grey kingbird	frequently	resting, foraging

Source: FWS 2018a; FPL 2018g

3.6.3.3 Important Habitats

Sections 2.2.1.6, 2.4.1.2, and 2.4.1.3 of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) describe several important terrestrial restoration efforts and habitats located within National Parks, preserves, and other federally owned, State-owned, County-owned, and privately-owned land. These include the following:

- Biscayne Bay National Park, which provides mangrove and other important habitat to wildlife and over 200 species of birds, 21 of which are Federally listed as threatened or endangered (NPS 2018a) (see pages 2-10 and 2-79 to 2-80 in NUREG–2176 (NRC 2016a)).
- Everglades National Park, which encompasses approximately 1.5 million ac (607,000 ha) of wetlands, open water, and other important habitats for a variety of wildlife and birds (see pages 2-11, 2-80, and 2-110 in NUREG–2176 (NRC 2016a)).
- The Comprehensive Everglades Restoration Plan (CERP) was approved by Congress in 2000 to restore, preserve, and protect the south Florida wetlands ecosystem while providing for other water-related needs of the region. The area covered by this plan includes the entire Everglades ecosystem. This interagency effort is one of the largest ecosystem restoration efforts in the country and includes multiple smaller efforts, such as the Biscayne Bay Coast Wetlands project (NPS 2018a; sees page 2-11 and 2-80 in NUREG–2176 (NRC 2016a)).
- South Dade Wetlands Project, also referred to as Model Lands, which is co-managed by Miami-Dade County's Department of Environmental Resources and the Southwest Florida Water Management System. These areas include over 20,000 ac (8,000 ha) of publicly owned conservation lands, including Miami-Dade County Environmentally Endangered Lands (DERM 2018). These wetlands serve as habitat and refuge for a variety of wildlife, including numerous federally listed and State-listed threatened and endangered species (see pages 2-10 and 2-133 in NUREG–2176 (NRC 2016a)).
- Everglades Mitigation Bank, which is a 13,000 ac (5,300 ha) expanse of freshwater and estuarine wetlands west and south of the Turkey Point CCS. FPL owns the Everglades Mitigation Bank and operates it as a commercial mitigation bank offering wetland habitat credits that can be purchased to offset regional wetland impacts (see pages 2-12 and 2-133 in NUREG–2176 (NRC 2016a)).

The NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) identifies other important habitats that occur within the vicinity of the Turkey Point site, such as mangrove forests (pages 2-109 to 2-110), pine rockland (page 2-110), marl prairie (page 2-110), and wetlands (page 2-110). The NRC staff incorporates this information from NUREG–2176 into this SEIS by reference (NRC 2016a: pages 2-109 to 2-110). Federally listed and State-listed threatened or endangered species that have the potential to occur within these important terrestrial habitats are described in pages 2-84 through 2-109 of NUREG–2176 (NRC 2016a), which information is also incorporated by reference herein.

3.6.4 Invasive and Non-Native Species

Several invasive and non-native species occur at Turkey Point. Although FPL does not formally record the occurrence of such species, common invasive species on the Turkey Point site include Australian pine (*Casuarina equisetifolia*), beach naupaka (*Scaevola sericea*), Brazilian pepper (*Schinus terebinthifolius*), Burma reed (*Neyraudia reynaudiana*), and melaleuca (*Melaleuca quinquenervia*) (FPL 2018g). The Argentine black-and-white tegu (*Tupanimbis merianae*) has also been observed at Turkey Point (NRC 2016a). This egg-eating lizard is an omnivore with the potential to affect many species, including alligators and crocodiles, and is the subject of a multiagency control effort in the immediate vicinity of the Turkey Point site. As described in Section 4.6.1.1, FPL (FPL 2018g) maintains a program to remove invasive species from the CCS on an annual basis.

3.7 Aquatic Resources

This section describes the aquatic resources of the affected environment, including the South Florida Coastal Plain Ecoregion, the CCS, Biscayne Bay, and Card Sound.

3.7.1 South Florida Coastal Plain Ecoregion

The Turkey Point site is located within the Southern Florida Coastal Plain ecoregion. This ecoregion is characterized by a hydrologically interconnected, slow-flowing network of wetland and aquatic systems, including ridge and slough landscapes, sawgrass plains, cypress and mangrove swamps, and coastal lagoons and bays. The Everglades, a subtropical wetland ecosystem that hosts a rich diversity of aquatic habitats and plant and animal species, comprise much of the ecoregion. The Florida Keys, barrier islands that extend along the extreme southern coast of the Florida Peninsula, protect estuarine bays and coves from the Atlantic Ocean and create important spawning habitats. The South Florida Coastal Plain ecoregion is also known for the Florida reef, the only living coral reef tract in the continental United States.

Beginning in the early 1900s, the hydrology of the ecoregion has been highly altered by human activity to support agricultural and urban development. In 1948, Congress authorized the creation of the Central and Southern Florida Flood Control Project, one of the largest water management systems in the world. Through this project, a series of canals were created across southern Florida to drain the land for flood control, water supply and retention, irrigation, and transportation. Subsequent land drainage resulted in the loss or conversion of a substantial portion of the original wetland system, reduced sheet flow dramatically, and created point-source discharge of freshwater into estuarine waters and coastal wetlands. The coastal areas of the ecoregion have also become highly populated and dense beachfront development is common. Nevertheless, a large portion of the ecoregion remains protected at the county, State, or Federal level and is managed to maintain and restore the region's unique and sensitive habitats. Section 2.4.2, "Aquatic Ecology," of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) provides more detailed information on the South Florida Coastal Plain ecoregion, including anthropogenic alterations and other past changes to the environment. The NRC staff incorporates the NUREG-2176 descriptions of the ecoregion into this SEIS by reference.

3.7.2 Aquatic Resources near the Turkey Point Site

The region surrounding Turkey Point contains shallow subtropical estuarine and marine environments, including Biscayne Bay and its associated park and preserve; Florida Keys National Marine Sanctuary; Card Sound and Canal; the Everglades Mitigation Bank, Model Lands Basin, and Southern Glades Addition; as well as Everglades National Park and the Crocodile Lake National Wildlife Refuge.

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 the bay and separates the bay 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. 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 ft (1.5 m) at mean low water, and its maximum depth is approximately 13 ft (4.0 m). Salinity is highly influenced by rainfall and ranges from 24 to 44 PSU. Annual surface water temperatures range from 59 °F to 92 °F (15 °C to 33 °C). The bay’s shallow depths and low spring tidal range (3 ft (0.9 m) maximum) result in a vertically well-mixed system with weak stratification.

Within the bay, Biscayne National Park encompasses 173,000 ac (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 immense 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 federally listed Florida manatee (*Trichechus manatus latirostris*), smalltooth sawfish (*Pristis pectinata*), American crocodile (*Crocodylus acutus*), and Johnson's seagrass (*Halophila johnsonii*) (FDEP 2017b). Johnson's seagrass is the first and only marine plant to be listed as threatened under the Endangered Species Act.

The Biscayne Bay Aquatic Preserve includes 67,000 ac (27,000 ha) of sovereign submerged lands managed by the Florida Department of Environmental Protection’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 Florida Department of Environmental Protection designated the waters within the Biscayne Bay Aquatic Preserve as Outstanding Florida Waters for waters worthy of special protection because of natural attributes. Under the Outstanding Florida Waters designation, the State cannot issue permits for direct discharges that would lower ambient water quality (FDEP 2017a).

Card Sound is a shallow bay south of the Turkey Point site with limited connection to the Atlantic Ocean. It 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 remaining on the east coast of Florida and provide 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 the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) describes Biscayne Bay, Card Sound, and other nearby aquatic resources in detail. The NRC staff incorporates those descriptions from NUREG–2176 into this SEIS by reference. In addition, see Section 3.7.4 of this SEIS for a detailed discussion of FPL's semiannual monitoring of Biscayne Bay and Card Sound.

3.7.3 Aquatic Resources on the Turkey Point Site

Within the Turkey Point site, the primary aquatic environment is the cooling canal system (CCS). The CCS occupies an area that is approximately 2 mi (3.2 km) wide by 5 mi (8 km) long and includes 168 mi (270 km) of earthen canals that cover an effective water surface area of approximately of 4,370 ac (1,770 ha) and a total surface area of 5,900 ac (24 km^2) (FPL 2018f, NRC 2002c). The CCS's channels are about 200 feet (60 m) wide and range in depth from 1 to 3 feet (0.3 to 1 m) (FPL 2018f). FPL constructed the CCS to use as an industrial wastewater facility. For a description of the CCS operations, see Section 3.1.3, "Cooling and Auxiliary Water Systems," in this SEIS.

The CCS has historically supported a variety of fish, mollusks, crabs, and submerged aquatic vegetation that are tolerant of shallow, subtropical, hypersaline environments such as sheepshead minnow (*Cyprinodon variegatus*) and several *Fundulus* species. FPL (FPL 2014a) reported that the species identified in Table 3-8 were present in the CCS as of November 2007. Because 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 FPL controls the entirety of the CCS and does not allow the public to access it.

Table 3-8 Aquatic Species Reported from the Cooling Canal System, November 2007

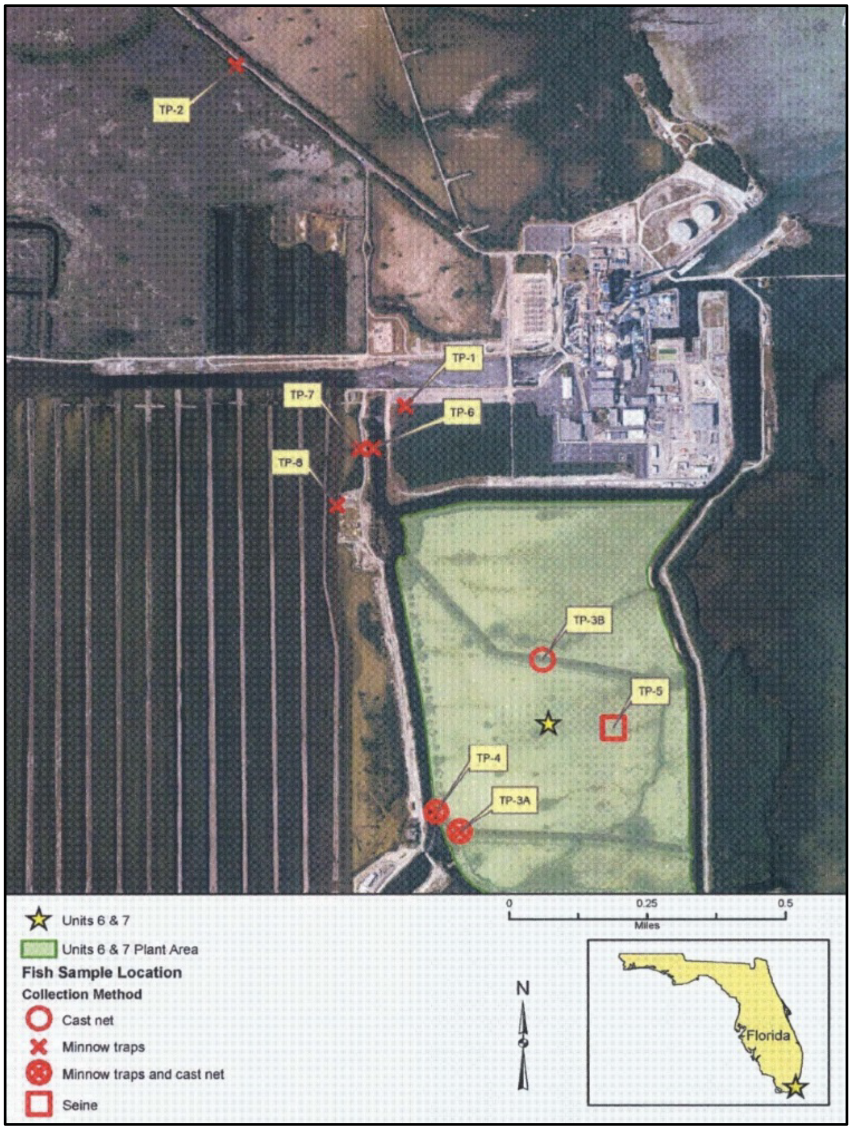
Species	Common Name
Fish	
Centropomus undecimalis	common snook
Cyprinodon variegatus	sheepshead minnow
Fundulus spp.	killifish
Gambusia spp.	mosquitofish
Megalops atlanticus	tarpon
Mugil spp.	mullet
Poecilia latipinna	sailfin molly
Strongylura spp.	needlefish
Mollusks	
Busycon contrarium	lightning whelk
Cerithium eburneum	ivory cerith
Isognomon alatus	flat tree oyster
Isognomon radiatus	Lister's tree oyster
Marisa cornuarietis	giant rams horm
Melampus bidentatus	eastern melamphus
Melongena corona	Florida crown conch

Species	Common Name
Tellin spp.	tellin
Crustaceans	
Cardisoma guanhumi	great land crab
Uca spp.	fiddler crab
Submerged Aquatic Vegetation	
Acetabularia spp.	mermaid's wineglass (green algae)
Batophora spp.	green algae
Caulerpa spp.	green algae
Ruppia maritima	widgeon grass
Source: adapted from FPL 2014a	

Other onsite aquatic resources at Turkey Point 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 property in both CCS and non-CCS waters. Sampling locations, which are depicted in Figure 3-20, 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 75.0 to 97.7 °F (23.9 to 36.5 °C), salinity was above 50 PSU at six sampling stations (TP-3A, TP-4, TP-5, TP-6, TP-7, and TP-8), and salinity was less than or equal to 1.5 PSU 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-ft (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: the killifishes (family Cyprinodontidae) and the livebearers (family Poeciliidae). Sheepshead minnow was the dominant species; this fish species 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. Table 3-9 identifies the collected species, relative abundances, and collection locations.



Source: Tetra Tech 2009, Figure 1

Figure 3-20 Turkey Point Site Fish Survey Sample Locations, June 2009

Table 3-9 Number and Relative Abundance of Fish Captured at Seven Locations on the Turkey Point Site, June 2009

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

Source: Tetra Tech 2009

Prior to 2010, the CCS environment was of low turbidity and contained low and stable nutrient levels. Widgeon grass (*Ruppia maritima*) beds 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 2016l).

In 2010, the CCS began experiencing a pronounced ecosystem shift. The average salinity of the CCS increased, water quality and clarity began to degrade, and average surface water temperatures increased. Seagrass colonies began to die off due to salinity- and high temperature-related stress. By 2012, very few seagrass beds remained in the CCS. 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 2016l).

To address CCS water quality degradation and as a requirement of the 2016 FDEP Consent Order, FPL began implementing a nutrient management plan (FPL 2016l) in 2016. The plan includes short- and long-term initiatives. One initiative is to re-establish seagrass meadows within the CCS. FPL (FPL 2016l) states in its plan that a healthy seagrass population of approximately 50 percent of the surface water acreage would help balance and sequester the CCS's nutrient content. Seagrasses require non-turbid, clear water with near-ocean salinity levels (roughly 30 to 37 PSU). 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, which would 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 FPL reduces nutrients and lowers salinities, FPL will cultivate and plant seagrass beds within areas of the CCS with appropriate depth and substrate. As CCS conditions improve, some dormant seagrass seeds in the CCS may also germinate such that seagrasses may reemerge naturally. Once re-established, a healthy seagrass population will provide a significant mechanism for uptake and retention of nutrients, thus reducing nutrient concentrations in the water. Lower nutrient concentrations in the water will deter algal blooms and fewer algal blooms will lead to greater water clarity. FPL's nutrient management plan sets a seagrass colonization target at 50 percent of the CCS water acreage. Section 3.5.1.4 describes the plan in more detail under the subsection titled, "Nutrient Management Plan for the Cooling Canal System."

To determine the presence, relative abundance, and distribution of fish, invertebrate, and seagrass populations currently within the CCS, FPL commissioned Ecological Associates, Inc. (EAI) to conduct a biological characterization study in December 2016 (EAI 2017). EAI established ten sampling stations within the CCS chosen to represent different benthic habitats, salinity gradients, and temperature regimes (see Figure 3-21). Seven 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.

Source: EAI 2017, Figure 1

Figure 3-21 Cooling Canal System 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 of 4 taxa: sheepshead minnow, sailfin molly, eastern mosquitofish (*Gambusia holbrooki*), and mudflat fiddler crabs (*Uca rapax*). Cast net samples yielded 282 fish: 259 sheepshead minnow, 22 sailfin molly, and 1 eastern mosquitofish. All fish collected during cast netting were small (less than 45 mm (1.75 inch) 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 inch) standard length, and crabs ranged from 8 to 11 mm (0.3 to 0.43 inch) carapace length and 11 to 15 mm (0.43 to 0.59 inch) carapace width.

Sheepshead minnow were abundant throughout the CCS and were found at all 10 sampling stations during the CCS characterization study. This species can live and successfully reproduce in high salinity waters (up to 147 PSU) and high temperatures (up to 109.4 °F (43 °C)) (Johnson 1974). Sailfin mollies were moderately abundant throughout the system. This species is also able to tolerate high salinities (up to 80 PSU), high temperatures (up to 104 °F (40 °C)), 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 high temperatures (up to 100.4 °F (38 °C)), hypersaline (up to 58.8 PSU) waters with low dissolved oxygen (Chervinski 1983, Specziar 2004). Mudflat fiddler crabs were captured incidentally with sampling methods not designed to capture crabs, so EIA 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 present due to recruitment by immigration into the system. EIA 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 EAI subsequently processed in a laboratory. A total of 79 individuals of 3 taxa were identified. The polychaete *Capitella capitate* 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, no live mollusk specimens were collected.

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 type present in the CCS, can grow in waters ranging from 64.4 to 86 °F (18 to 30 °C), although temperatures above 73.4 to 77 °F (23 to 25 °C) have a negative influence on photosynthesis (Arnold et al. 2017). One study on the effect of salinity on the species determined that 8- to 12-week old plants could not tolerate salinities above 21,000 parts per million (ppm) (Mayer and Low 1970). This equates to approximately 21 PSU.

During the CCS characterization study, EAI observed no 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's turbid water conditions, high salinity, and high temperatures.

While differences in sampling methods and effort make definitive conclusions difficult to determine, 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 in 2016. 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.

3.7.4 Biscayne Bay and Card Sound Semiannual Monitoring

Since September 2010, FPL has commissioned ongoing, semiannual ecological monitoring of the Turkey Point site and surrounding environment, including Biscayne Bay, as a requirement of the Florida Department of Environmental Protection's Conditions of Certification in connection with the Turkey Point extended power uprate and the South Florida Water Management District's Fifth Supplemental Agreement. 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 (see Figure 3-22). Within each of the study areas, ecological conditions are monitored along two 2-km (1.2-mi)-long shore-parallel transects (designated "a" and "b" for each study area) that lie approximately 250 and 500 m (0.16 and 0.32 mi) from shore. Each transect is divided into eight 250-m (0.16-mi)-long segments, and a 1-m^2 (0.6-mi^2) 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 State-approved monitoring plan.

At each sampling location, submerged aquatic vegetation is surveyed and categorized 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 report (E&E 2017), ecological monitoring findings were similar to those reported in previous post-uprate annual monitoring reports. Ecology and Environment Inc.'s (E&E's 2017) major findings were as follows.

- The marsh and mangrove areas are representative of the hydrologically modified or nutrient-limited 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, and there is no clear evidence of CCS water in the surrounding marsh or mangrove areas from a groundwater pathway. Rather, ecological changes observed during the reporting period are more seasonally and meteorologically driven.

Source: E&E 2017, Figure 1.3-1

Figure 3-22 Biscayne Bay and Card Sound Semiannual Monitoring Ecological Transection Locations

3.7.5 Additional Information on Aquatic Resources

Section 2.4.2, “Aquatic Ecology,” of the NRC staff’s EIS for Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) provides more information on the following aspects of the aquatic environment:

- Turkey Point ecoregion (pages 2-119 to 2-122)
- Historical conditions and anthropogenic alterations to the Turkey Point ecoregion (pages 2-119 to 2-122)
- Detailed descriptions of aquatic resources on the Turkey Point site (pages 2-122 to 2-128; Table 2-18 and Table 2-19)
- Descriptions of the CCS and its water quality through 2016 (pages 2-123 to 2-126)
- Summaries of macroinvertebrate and seagrass surveys performed in near-shore areas of Biscayne Bay in 2008 and 2009 to support the Turkey Point 6 and 7 combined licenses application (pages 2-123 to 2-128 and 2-159 to 2-160; Table 2-18 and Table 2-20)
- Descriptions of nearby aquatic environments, which include Biscayne Bay and its associated park and preserve, Florida Keys National Marine Sanctuary, Card Sound and Canal, the Everglades Mitigation Bank, Everglades National Park, and the Crocodile Lake National Wildlife Refuge (pages 2-128 through 2-134; Tables 2-21 through 2-25)
- Ecologically, commercially, and recreationally important species (pages 2-136 to 2-142; Table 2-27)
- State-listed threatened or endangered species and species of concern (page 2-154 to 2-157; Table 2-30)
- Nonindigenous and invasive species (page 2-142)

The NRC staff incorporates this information from NUREG–2176 as indicated by the section, page, and table numbers above, into this SEIS by reference. The NRC staff did not identify any new or updated information relevant to the description of the aquatic environment beyond the additional information previously described in this section.

3.8 Special Status Species and Habitats

This section addresses species and habitats that are federally protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA), and the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.) (MSA). Prior to taking a Federal action, such as the issuance of the proposed Turkey Point subsequent renewed licenses, the NRC has direct responsibilities under these statutes. The terrestrial and aquatic resource sections of this SEIS (Sections 3.6 and 3.7, respectively) address species and habitats protected by other Federal statutes and the State of Florida under which the NRC does not have such responsibilities.

3.8.1 Species and Habitats Protected Under the Endangered Species Act

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service jointly administer the Endangered Species Act. The U.S. Fish and Wildlife Service manages the protection of, and recovery effort for, listed terrestrial and freshwater species, and the National Marine

Fisheries Service manages the protection of, and recovery effort for, listed marine and anadromous species. The following sections describe the Turkey Point action area and then consider separately those species that could occur in the action area under the jurisdiction of each Service.

<u>Turkey Point Action Area</u>

The implementing regulations for Section 7(a)(2) of the Endangered Species Act define "action area" as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02, "Definitions"). The action area effectively bounds the analysis of federally listed species and critical habitats because only species and habitats that occur within the action area may be affected by the Federal action.

For the purposes of assessing the potential impacts of Turkey Point subsequent license renewal on federally listed species, the NRC staff considers the action area to consist of the Turkey Point site, including the CCS, as well as Biscayne Bay. While most potential impacts associated with the proposed action would be confined to the Turkey Point site, continued Turkey Point operations would necessitate occasional delivery of large parts and equipment by barge over the course of the subsequent license renewal term. Such deliveries would require barge travel through Biscayne Bay, which is why the NRC staff includes this waterbody in the Turkey Point action area for subsequent license renewal.

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 Turkey Point action area seasonally as it forages or breeds. Thus, in its analysis, the NRC staff considers not only those species known to occur within the action area, but also those species that may passively or actively move into the action area. The staff then considers whether the life history of each species makes it likely to move into the action area where it could be affected by the proposed Turkey Point subsequent license renewal.

The following sections first discuss endangered or threatened species and critical habitats under the U.S. Fish and Wildlife Service's (FWS) jurisdiction followed by a discussion of those species under the National Marine Fisheries Service's (NMFS) jurisdiction.

3.8.1.1 Species and Habitats under U.S. Fish and Wildlife Service's Jurisdiction

The NRC staff used the 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 action area. The ECOS IPaC tool identified 42 federally listed endangered or threatened species under the U.S. Fish and Wildlife Service's sole jurisdiction with the potential to occur in the Turkey Point action area. The IPaC tool also identified designated critical habitat for two of these species in the Turkey Point action area (FWS 2018b) (see Table 3-10). No proposed species, candidate species, or proposed or designated critical habitat occurs within the action area (FWS 2018b). Table 3-10 describes the habitat requirements, occurrence patterns, and Federal status for each of the 42 federally listed species under FWS's sole jurisdiction.

In addition to these 42 species, FWS (FWS 2018b) identified 4 species for which FWS and NMFS have joint jurisdiction, including (1) the loggerhead sea turtle (*Caretta caretta*), (2) leatherback sea turtle (*Dermochelys coriacea*), (3) hawksbill sea turtle (*Eretmochelys imbricata*), and (4) the Atlantic Sturgeon (gulf Subspecies) (*Acipenser oxyrinchus (oxyrhynchus)* *desotoi*). However, the proposed action would have no effect on the nesting habitat of sea turtles or other portions of the life cycle that are under FWS's jurisdiction for these four species (NRC 2018g). The life history and impacts to these species under the jurisdiction of NMFS is described in Sections 3.8.1.2, "Species and Habitats under National Marine Fisheries Service," and 4.8.1.2, "Species and Habitats Protected Under the Magnuson–Stevens Act."

Table 3-10 Federally Listed Species under U.S. Fish and Wildlife Service Jurisdiction

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status[a]
		Mammals	
Eumops floridanus	Florida bonneted bat	Suitable roosting (e.g., palm trees, tree cavities, Spanish tiled roofs) and foraging habitat occurs at Turkey Point (FWS 2017a); Observed within the vicinity of Turkey Point (FPL 2018f).	Endangered
Puma concolor coryi	Florida panther	Florida Panther Focus Area occurs in the vicinity of Turkey Point (FWS 1999); Observed 2 mi west of Turkey Point (SFWMD 2013a).	Endangered
Puma concolor (all sub species except coryi)	puma	No known occurrences in Florida (FWS 1999; NRC 2016a).	SAT
Trichechus manatus	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 2012b).	Threatened
		Birds	
Ammodramus maritimus mirabilis	Cape Sable seaside sparrow	Suitable habitat (mixed marl prairie) does not occur at Turkey Point; No known occurrences at Turkey Point (NRC 2015a; FPL 2014a).	Endangered
Ammodramus savannarum	Florida Grasshopper sparrow	Extirpated from Miami-Dade County (FWS 1999).	Endangered
Aphelocoma coerulescens	Florida scrub-jay	Extirpated from Dade County (FWS 1999).	Threatened
Caladris rufa	red knot	Suitable habitat, such as mudflats, salt marshes, and mangroves occur onsite (FWS 2017a); Observed onsite (FPL 2014a).	Threatened
Campephilus principalis	ivory-billed woodpecker	Likely extirpated from the United States; No known occurrences on or near Turkey Point (FWS 1999 NRC 2016a).	Endangered
Charadrius melodus	piping plover	Suitable wintering habitat occurs onsite and within the vicinity, such as beaches, mudflats, and sandflats (FPL 2014a; FPL 2018f); No documented occurrences onsite (FPL 2014a; NRC 2015a)	Threatened
Mycteria americana	wood stork	Suitable foraging, resting, and roosting habitat within the CCS and onsite wetlands; Regularly observed onsite (NRC 2015a; EAI 2017; FPL 2018g).	Threatened

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status[(a)]
Picoides borealis	red-cockaded woodpecker	No known occurrences within Miami-Dade County (FWS 1999; NRC 2016a).	Endangered
Rostrhamus sociabilis	Everglades snail kite	Suitable habitat (lowland freshwater marshes) occurs on and near Turkey Point (NRC 2015a); Observed within the Everglades Mitigation Bank adjacent to Turkey Point (FPL 2014a).	Endangered
Setophaga kirtlandi	Kirtland's warbler	Suitable habitat (dense mangroves) occurs on and near Turkey Point; No known observations onsite (NRC 2016a; FPL 2018f).	Endangered
Vermivora bachmani	Bachman's warbler	No observations of this species in the United States since 1988 (FWS 1999).	Endangered
		Reptiles	
Alligator mississippiensis	American alligator	Suitable freshwater habitat occurs within the vicinity of Turkey Point (FPL 2018f).	SAT
Crocodylus acutus	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 2018f).	Threatened
Drymarchon corais couperi	eastern indigo snake	Suitable habitat, including freshwater marshes, mangroves, and cleared areas, occurs at Turkey Point; Regularly observed onsite (FPL 2018g).	Threatened
		Invertebrates	
Anaea troglodyta floridalis	Florida leafwing butterfly	Suitable habitat (pineland croton plants in pine rockland) does not occur at Turkey Point (FWS 2017a; FPL 2018f).	Endangered
Cyclargus (=Hemiargus) thomasi bethunebakeri	Miami blue butterfly	Only known occurrences are within Key West National Wildlife Refuge (FFWCC undated; FPL 2018f).	Endangered
Heraclides aristodemus ponceanus	Schaus swallowtail butterfly	Suitable habitat (pineland croton plants in pine rockland) does not occur at Turkey Point (FWS 2017a; FPL 2018f).	Endangered
Orthalicus reses	Stock Island Tree Snail	Suitable habitat (hardwood hammocks primarily in keys) does not occur at Turkey Point; No known occurrence within the vicinity of Turkey Point (FWS 1999; FPL 2018f).	Threatened
Strymon acis bartrami	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 2017a; FPL 2018f).	Endangered
		Flowering Plants	
Amorpha crenulata	crenulate lead-plant	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Argythamnia blodgettii	Blodgett's silverbush	Limited suitable habitat (coastal berm) may occur onsite; Observed within the vicinity of Turkey Point (FPL 2011b; Gann et al. 2018).	Threatened

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status[a]
Brickellia mosieri	Florida brickell-bush	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Chamaesyce deltoidea ssp. *deltoidea*	deltoid spurge	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Chamaesyce deltoidea pinetorum	pineland sandmat	Suitable habitat (pine rockland) does not occur at Turkey Point (NRC 2015a; 82 FR 6691).	Threatened
Chamaesyce garberi	Garber's spurge	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Threatened
Chromolaena frustrata	Cape Sable thoroughwort	Limited suitable habitat (coastal rock barrens) may occur at Turkey Point. Species does not occur in disturbed areas (FWS 2010a; FPL 2018f; NRC 2016a).	Endangered
Consolea corallicola	Florida semaphore cactus	Limited suitable habitat (coastal berms) may occur at Turkey Point (78 FR 63796; NRC 2016a); No known occurrences at Turkey Point (NRC 2016a; FPL 2018f).	Endangered
Cucurbita okeechobeensis ssp. *okeechobeensis*	Okeechobee Gourd	No known occurrences in Miami-Dade County; Not likely to occur at Turkey Point due to lake of suitable habitat (NRC 2016a; Gann et al. 2018; FPL 2018g).	Endangered
Dalea carthagenensis floridana	Florida prairie-clover	Suitable habitat not likely to occur at Turkey Point because some suitable habitats (i.e. pine rocklands, edges of rockland hammocks, and marl prairies) do not occur at Turkey Point and other suitable habitat (i.e., uplands) have been previously disturbed (NRC 2016a; Gann et al. 2018; FPL 2018g).	Endangered
Digitaria pauciflora	Florida pineland crabgrass	Suitable habitat (marl prairie and pine rockland) does not occur at Turkey Point (NRC 2016a; Gann et al. 2018; FPL 2018g).	Threatened
Galactia smallii	Small's milkpea	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Jacquemontia reclinata	beach jacquemontia	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Linum arenicola	sand flax	Potential to occur onsite given that this species grows less than 1 mi from Turkey Point and suitable habitat (i.e., pine rocklands, marl prairie, and adjacent disturbed areas) occurs within the vicinity (FPL 2018f).	Endangered
Linum carteri carteri	Carter's small-flowered flax	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Polygala smallii	tiny polygala	Suitable habitat (pine rockland) does not occur at Turkey Point (FWS 2017a).	Endangered
Sideroxylon reclinatum ssp. *austrofloridense*	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

Species	Common Name	Habitat Requirements and Occurrence Patterns	Federally Listed Status[(a)]
Warea carteri	Carter's mustard	Extirpated from Miami-Dade County (FWS 1999; FWS 2008a).	Endangered
		Ferns	
Trichomanes punctatum ssp. *floridanum*	Florida bristle fern	Suitable habitat (rockland hammocks, sinkhole habitats, and tree trunks that are in deep shade) occurs within the vicinity (Gann et al. 2018; NRC 2016a); Potential habitat onsite, although no known occurrences onsite (FPL 2018f).	Endangered

(a) SAT = Federally listed due to similarity of appearance to another listed species, Endangered = Federally listed as endangered, Threatened = Federally listed as threatened at 50 CFR Part 17, "Endangered and Threatened Wildlife and Plants," under provisions of the Endangered Species Act

Source: FWS 2018b

The FWS (FWS 2018b) identifies 23 animals that could occur within the Turkey Point action area. Based on the information in Table 3-10, 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, the NRC will not consider these further within this SEIS:

- 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 NRC staff also does not consider the following five species further within this SEIS because no suitable habitat for these species occurs on the Turkey Point site, there are no known occurrences of the species on site, 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 floridalis*)
- Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*)
- Stock Island Tree Snail (*Orthalicus reses*)
- Bartram's hairstreak butterfly (*Strymon acis bartrami*)

The following two species are federally listed because of their similarity in appearance to a federally listed endangered or threatened species. A species that is listed due to similarity of appearance is not biologically endangered or threatened and is not subject to ESA Section 7 consultation. Therefore, this SEIS does not discuss further these two species:

- Puma (*Puma concolor* (all sub species except coryi)) which was listed for similarity in appearance to the Florida panther (*Puma concolor coryi*)
- American alligator (*Alligator mississippiensis*) which was listed for similarity in appearance to American crocodile (*Crocodylus acutus*)

The FWS (FWS 2018b) identifies 19 plant species that could occur within the action area. FPL (FWS 2018f, FPL 2018n, FPL 2018g) is not aware of any federally listed endangered or threatened plant species on the Turkey Point site. The NRC staff did not identify any known occurrence of a federally listed plant species within the action area (FWS 1999, NRC 2016a, FWS 2017a, Gann et al. 2018), although some species have been observed within the vicinity of the action area and have the potential to occur onsite (FPL 2011b). 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 federally listed species in Table 3-10 to determine which plants have potential suitable habitat within the action area. The NRC staff determined that the following 14 federally listed plant species would not be expected to occur within the Turkey Point action area due to the lack of suitable habitat or because the 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*)

The remaining 15 federally listed species in Table 3-10 may occur within the action area. These are:

- 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)
- Everglades snail kite (*Rostrhamus sociabilis*)
- Kirtland's warbler (*Setophaga kirtlandi*)
- American crocodile (*Crocodylus acutus*)
- eastern indigo snake (Drymarchon corais couperi)
- 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)

The NRC staff evaluated the potential for the proposed action to affect these species in a biological assessment (NRC 2018n) for the Turkey Point Units 3 and 4 subsequent license renewal. The ESA Section 7 consultation history, life histories of these 15 species, and an evaluation of impacts to the 15 species can be found in the biological assessment. The NRC staff incorporates by reference that biological assessment (NRC 2018n) into this SEIS.

3.8.1.2 Species and Habitats under National Marine Fisheries Service's Jurisdiction

No federally listed endangered or threatened species under the National Marine Fisheries Service's jurisdiction occur on the Turkey Point site itself. Five federally listed species under the NMFS's jurisdiction may occur in Biscayne Bay adjacent to the Turkey Point site (see Table 3-11).

Table 3-11 Federally Listed Endangered or Threatened Species Under National Marine Fisheries Service Jurisdiction in Biscayne Bay

Species	Common Name	Distinct Population Segment(s)[(a)]	Federally Listed Status[(b)]
		Fish	
Pristis pectinata	smalltooth sawfish	United States	Endangered
		Sea Turtles	
Caretta caretta	loggerhead	—	Threatened
Chelonia mydas	green	North Atlantic and South Atlantic	Threatened
Dermochelys coriacea	leatherback	—	Endangered
Eretmochelys imbricata	hawksbill	—	Endangered

[(a)] Under the Endangered Species Act, a Distinct Population Segment is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species.

[(b)] Endangered = Federally listed as endangered and Threatened = Federally listed as threatened at 50 CFR Part 17, "Endangered and Threatened Wildlife and Plants," under the provisions of the Endangered Species Act.

Source: NMFS 2017a

In 2015, the NRC prepared a biological assessment for the above five species as well as other species to assess the impacts of construction and operation of proposed new reactors Turkey Point Units 6 and 7 (NRC 2015b). Section 5.0, "Baseline Conditions for Aquatic Species," of the staff's biological assessment for Turkey Point Units 6 and 7 contains life histories, habitat requirements, status and distributions, factors contributing to the species' decline, and the occurrence and status in the project area of the smalltooth sawfish and four sea turtles identified in Table 3-11 on the pages identified as follows:

- smalltooth sawfish (pages 5-15 to 5-18; Figure 5-4 and Figure 5-5)
- loggerhead sea turtle (pages 5-7 to 5-10; Figure 5-3; Table 5-3)
- green sea turtle (pages 5-5 to 5-7; Table 5-2)
- leatherback sea turtle (pages 5-12 to 5-13; Table 5-5)
- hawksbill sea turtle (pages 5-10 to 5-12; Table 5-4)

In that biological assessment, the NRC staff also identified sea turtle stranding information for South Florida and in the vicinity of the Turkey Point site in the assessment (pages 5-1 to 5-5;

Figure 5-1 and Figure 5-2; Table 5-1). This information, as identified by page, table, and figure numbers above, continues to accurately describe these species. Accordingly, the NRC staff incorporates that information into this SEIS by reference.

Because there are no surface water connections between the CCS and any natural surface water bodies, none of the species under the NMFS's jurisdiction occur in the CCS or on the Turkey Point site itself. However, all five of the federally listed species may be present in Biscayne Bay and are, therefore, considered to be present in the action area. Documented occurrences of smalltooth sawfish in or near the Turkey Point action area are rare, and, if present, would likely consist of juveniles using the near-shore mangrove communities to avoid predation (NRC 2015b). Leatherback and hawksbill sea turtle stranding data indicate that these species would also rarely occur in Biscayne Bay (NRC 2015b). Loggerhead and green sea turtles are more likely to occur in Biscayne Bay based on stranding data, although occurrences of these species within the Turkey Point action area itself are not particularly common (NRC 2015b).

3.8.2 Species and Habitats Protected under the Magnuson–Stevens Act

The South Atlantic Fishery Management Council and the NMFS have designated Essential Fish Habitat (EFH) pursuant to the Magnuson–Stevens Act for a number of federally managed species within Biscayne Bay. During the NRC staff's environmental review for the Turkey Point Units 6 and 7 combined license application, the NRC staff worked with the NMFS to identify those species with EFH present near the Turkey Point site. Table 3-12 identifies these species, the applicable fisheries management plan, and relevant EFH habitat designations. During the preparation of this SEIS, the NRC staff confirmed through the NMFS's EFH Mapper that these designations remain valid and that no new EFH has been designated in the vicinity of Turkey Point since the staff's environmental review of the Turkey Point Units 6 and 7 combined license application.

Table 3-12 Designated Essential Fish Habitat near the Turkey Point Site

Species	Common Name	Applicable Fishery Management Plan[a]	Essential Fish Habitat Designation[b]	
			Mangrove	Seagrass and Unconsolidated Bottom
Farfantepenaeus duorarum	pink shrimp	Shrimp Fishery	x	x
Haemulon plumieri	white grunt	Snapper-Grouper		x
Lutianus analis	mutton snapper	Snapper-Grouper		x
Lutjanus griseus	gray snapper	Snapper-Grouper	x	x
Panulirus argus	spiny lobster	Spiny Lobster	x	x

[a] The Fishery Management Councils and the NMFS designate EFH for federally managed species through fishery management plans.

[b] Biscayne Bay and Biscayne National Park are also EFH Habitats of Particular Concern for coral, coral reefs, and hard-bottom communities.

Sources: NMFS 201a, NRC 2015c, NRC 2016a, SAFMC and NMFS 2016a

In 2015, the NRC staff prepared an Essential Fish Habitat assessment to assess the impacts of construction and operation of proposed Turkey Point Units 6 and 7 (NRC 2015c). Section 4.0, “EFH Species Life-History Information,” of the staff’s EFH assessment describes life histories, habitat requirements, distributions, and population statuses of the five federally managed species identified in Table 3-12 on the pages identified as follows:

- pink shrimp (pages 4-4 to 4-5)
- white grunt (page 4-3)
- mutton snapper (page 4-3)
- gray snapper (pages 4-1 to 4-2, Figure 4-1)
- spiny lobster (pages 4 3 to 4-4, Figure 4-2)

The NRC staff also described in its EFH assessment the applicable fishery management plans for these species (page 3-2) and habitat areas of particular concern (page 3-3). This information, as identified above, continues to accurately describe these species, and the NRC staff therefore incorporates it into this SEIS by reference. The NRC staff addressed two additional species—bluestriped grunt (*Haemulon sciurus*) and dog snapper (*Lutianus jocu*) —in its 2015 EFH assessment. However, the South Atlantic Fishery Management Council and the NMFS have since removed these species from the snapper-grouper complex (77 FR 15916, 81 FR 32249). Thus, the Snapper-Grouper Fishery Management Plan no longer identifies EFH for these species.

While EFH for the species identified in Table 3-12 is designated in Biscayne Bay, neither EFH nor the species themselves occur in the CCS or on the Turkey Point site because there are no surface water connections between the CCS and any other natural surface water bodies.

3.9 <u>Historic and Cultural Resources</u>

This section describes the cultural background and the historic and cultural resources found at Turkey Point and in the surrounding area. Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) (54 U.S.C. 300101 et seq.), requires Federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to review and comment on the undertaking. Undertakings denote a broad range of Federal activities, including the issuance of NRC reactor licenses and permits. Historic properties are defined as resources included on, or eligible for inclusion on, the National Register of Historic Places (National Register). The criteria for eligibility are listed in Title 36, "Parks, Forest, and Public Property," of the *Code of Federal Regulations* (36 CFR) Section 60.4, "Criteria for evaluation," and include (1) association with significant events in history, (2) association with the lives of persons significant in the past, (3) embodiment of distinctive characteristics of type, period, or method of construction, and (4) sites or places that have yielded, or are likely to yield, information important in prehistory or history.

In accordance with 36 CFR 800.8(c), "Use of the NEPA process for section 106 purposes," the NRC complies with the obligation required under Section 106 of the NHPA through its environmental review process under the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq). In the context of the NHPA, the area of potential effect (APE) for a license renewal action is the Turkey Point site and its immediate environs. Turkey Point is located within the 9,460 ac (3,828 ha) FPL property. This property constitutes the APE and consists primarily of developed land, open water, and wetlands. These land areas may be impacted by continued maintenance and operations activities during the subsequent license renewal term. The APE may extend beyond the immediate Turkey Point environs if FPL's maintenance and operations activities affect offsite historic properties irrespective of land ownership or control.

In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties within the APE. The NRC is required to, in consultation with the SHPO, determine and document the APE and identify historic properties within the APE. If the NRC finds that either there are no historic properties within the APE or the undertaking (subsequent license renewal) would have no effects on historic properties, the NRC provides documentation of this finding to the State historic preservation officer. In addition, the NRC notifies all consulting parties, including Indian tribes, and makes this finding public (through the NEPA process) prior to issuing the renewed license. If historic properties are present and could be affected by the undertaking, the NRC is required to assess and resolve any adverse effects in consultation with the State historic preservation officer and any Indian Tribe that attaches religious and cultural significance to identified historic properties. The Florida Division of Historical Resources, within the Florida Department of State, is responsible for preserving and promoting Florida's historical, archaeological, and folk culture resources.

3.9.1 Cultural Background

Humans have occupied the southern Florida region for about 12,000 years. The NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176), Section 2.7.1 describes in detail the history of human occupation of the Turkey Point site and the surrounding region (NRC 2016a). The NRC staff incorporates this prehistoric occupation description, contained in pages 2-197 through 2-198 of NUREG-2176, into this SEIS by reference. Prehistoric occupation of the area is divided into the following chronological sequence:

- Paleoindian Period (12,000-7,500 BC)
- Archaic Period (7,500-500 BC)
- Formative Period (500 BC -1513 AD)

The history of east coast Florida from European contact to the end of World War II is described on pages 2-199 through 2-201 of NUREG–2176 (NRC 2016a). The NRC staff incorporates these pages into this SEIS by reference. In brief, European arrival and contact with aboriginal people of southern Florida occurred in 1513 when Spanish explorers arrived on Florida's eastern coast. European colonization resulted in the loss of Tribal lands and the decline of Native American populations. In 1821, Spain ceded Florida Territory to the United States, and Florida was granted statehood in 1845. During World War I, several training facilities were set up in the State of Florida. The State's economy was boosted by the war, primarily through shipbuilding and industrialization of port cities. During World War II, Florida became one of the Nation's major training grounds for various military branches, and the influx of thousands of servicemen and their families increased industrial and agricultural production in Florida. With the establishment of the Everglades National Park in 1947, tourism increased in the area and became one of the major sources of the State's economy. The NRC staff has identified no new and significant information related to the cultural history of the Turkey Point region in its review of FPL's environmental report submitted as part of the subsequent license renewal application (FPL 2018f), during the onsite environmental audit at Turkey Point, or through the scoping process, beyond the information in the EIS for Turkey Point Units 6 and 7.

3.9.2 Historic and Cultural Resources at Turkey Point

Historic and cultural resources in the vicinity of Turkey Point can include prehistoric era and historic era archaeological sites, historic districts, and buildings, as well as any site, structure, or object that may be considered eligible for listing on the National Register of Historic Places (NRHP). Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture. "Historic property" is the legal term for a historic or cultural resource that is included on, or eligible for inclusion on, the NRHP. The staff notes that the vicinity of a site is not equivalent to an APE; rather, it is the area within a 6-mi (9.6 km) radius of the plant, as explained in NUREG–1555, Supplement 1, Rev. 1.

A cultural resource survey was not conducted on the FPL site prior to Turkey Point's construction (FPL 2018f). Construction of Turkey Point likely disturbed any historic and archaeological resource that may have been located within its footprint. Approximately 28 percent (2,700 ac (1093 ha)) of the site is undeveloped and undisturbed (FPL 2018h). Although no comprehensive cultural resource survey has been completed for the entire Turkey Point site, several cultural resource studies of the site were conducted on portions of the site between 2004 and 2013 (FPL 2018f, Janus 2009, FPL 2018h). FPL estimates that approximately 10 percent of the Turkey Point site (approximately 950 ac (384 ha)) has been surveyed collectively between these cultural resource surveys (FPL 2018h). These cultural resource studies did not identify archeological sites or historic resources on the Turkey Point site areas that were surveyed, and they concluded that the Turkey Point site has a low archeological potential (FPL 2018f and Janus 2009).

During the NRC staff's environmental site audit, the NRC staff became aware of three wooden buildings that were part of a Boy Scouts of America camp and a cottage (known as the Range House/McGregor Smith Cottage) that are over 50 years old and could have potential historic significance (FPL 2018h). The Boy Scout camp was constructed by FPL between 1962 and 1963 (FPL 2018m). After FPL completed construction of the cooling canals in the early 1970s, the Boy Scout camp was no longer used for Boy Scout activities (FPL 2018m). FPL has maintained and repaired the three wooden structures associated with the former Boy Scout camp, and now uses these structures for storage (NRC 1972, FPL 2018h, FPL 2018m). Two of these structures have gable roofs, and the third has a pyramid roof. Although they have not yet been formally evaluated, FPL has indicated that the three structures do not appear to meet the criteria for listing on the NRHP (FPL 2018h, FPL 2018m).

The Ranger House/McGregor Smith Cottage is a wood frame elevated structure supported by large cylindrical wooden posts; the ground floor space and second level wraparound porch are enclosed with screens (MDC 2018d). The structure was built sometime between 1965 and 1968 for the purposes of housing a full-time Florida Board of Conservation ranger (FPL 2018m). The structure is named after McGregor Smith, one of Florida Power & Light's first presidents (from 1939–1954), who later served as chief executive officer. According to FPL, McGregor Smith is also known for his involvement with the Boy Scouts and southern Florida economic development (FPL 2018h). Past use of the cottage included use as a meeting space during construction of Turkey Point and as a construction office and fish camp during the 1980s. During the 1990s, the cottage was renovated to make it a habitable residence for senior FPL staff (FPL 2018m). In 2012, FPL contacted the Miami-Dade County's Office of Historical Resources to discuss designation of the Ranger House/McGregor Smith Cottage for historical landmark status and potential restoration of the cottage. According to Miami-Dade County's Office of Historical Resources, McGregor Smith was an important figure in the history of the Florida Power & Light Company and the cottage "played a significant role in the early history of the FPL power plant at Turkey Point and is worthy of saving for future staff use and as a vestige of the flurry of activity that once took place in and around the power plant during the 1960s." However, in 2012 when FPL contacted the Miami-Dade County's Office of Historical Resources, the Ranger House/McGregor Smith Cottage had not yet met the 50-year benchmark required for consideration for eligibility for listing in the NRHP (MDC 2018d). As of the date of publication of this SEIS, FPL has not evaluated the Ranger House/McGregor Smith Cottage for eligibility for listing in the NRHP (FPL 2018h).

FPL conducted a desktop study of offsite cultural resources within the vicinity of Turkey Point. Within a 6-mi (9.6 km) radius of the Turkey Point site, there are 95 known historic and cultural resources. Of these, 28 resources are ineligible for listing, 65 resources have not been evaluated for listing, and 2 resources have been determined eligible for listing in the NRHP (FPL 2018f).

3.10 <u>Socioeconomics</u>

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Turkey Point. Turkey Point and the communities that support it can be described as a dynamic socioeconomic system. The communities supply the people, goods, and services required to operate the nuclear power plant. Power plant operations, in turn, supply wages and benefits for people and dollar expenditures for goods and services. The measure of a community's ability to support Turkey Point operations depends on the community's ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Power Plant Employment

The socioeconomic region of influence (ROI) is defined by the area where Turkey Point workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions of the region. Currently, FPL employs a permanent workforce of approximately 680 workers (FPL 2018f). Approximately 85 percent of this workforce resides in Miami-Dade County (Table 3-13). The remaining workers are spread among 12 counties in Florida and Georgia, with numbers ranging from 1 worker to 49 workers per county (FPL 2018f). In addition to permanent Turkey Point plant employees, FPL hires contract workers to support plant operations. In 2017, FPL employed 366 onsite contract workers; 80 percent of the contract workers resided in Miami-Dade County. The number of contract workers employed each year has remained relatively stable for the last 5 years with the exception of one year. In 2013, FPL employed 763 onsite contract workers as a result of the extended power uprate for Turkey Point (FPL 2018h). Since the majority of permanent workers (85 percent) and contract workers (80 percent) reside in Miami-Dade County, the most significant socioeconomic effects of plant operations are likely to occur in this county. The focus of the impact analysis and region of influence, therefore, is on the socioeconomic impacts of continued Turkey Point operations during the subsequent license renewal period on Miami-Dade County.

Table 3-13 Residence of Permanent Turkey Point Employees by County

County	Number of Employees	Percentage of Total
Total	679	100
Florida		
Broward	49	7
Miami-Dade	577	85
Monroe	40	6
Palm Beach	4	1
Other states and counties	9	1

Source: FPL 2018f

Refueling outages for Turkey Point Units 3 and 4 occur on a staggered 18-month schedule for each unit and have historically lasted 25 to 35 days per unit. During refueling outages, onsite employment typically increases by an additional 1,200 workers. As there are no subsequent license renewal-related refurbishment activities, FPL has no plans to add additional employees to support plant operations during the subsequent license renewal period (FPL 2018f).

3.10.2 Regional Economic Characteristics

This section presents information on employment and income in the Turkey Point socioeconomic region of influence.

3.10.2.1 Regional Employment and Income

In 2016, the Miami-Dade County civilian labor force was approximately 1,370,950 individuals (USCB 2016a). From 2011 to 2016, the labor force in Miami-Dade County increased by 5.6 percent (USCB 2016a and USCB 2011). From 2011 to 2016, the number of employed people in Miami-Dade County increased by 14 percent.

According to the U.S. Census Bureau's (USCB's) 2016 American Community Survey 1-year Estimates, educational services, and health care and social assistance represents the largest employment sector in Miami-Dade County (approximately 20 percent), followed by professional, scientific, and management, and administrative and waste management services (approximately 13 percent). A list of employment by industry in Miami-Dade County is provided in Table 3-14. Turkey Point's permanent workforce residing in Miami-Dade County represents approximately 0.04 percent of Miami-Dade County's employed civilian labor force. Estimated income information for the Miami-Dade County and Florida, for comparison, is presented in Table 3-15. National parks in the vicinity of Turkey Point, such as Biscayne National Park and the Everglades National Park, attract visitors that support economic activity. For instance, in 2017, Biscayne National Park and the Everglades National Park supported approximately 1,680 jobs and $65,319,000 in labor income (NPS 2018b).

Table 3-14 Employment by Industry in Miami-Dade County (2016 Estimates)

Industry	Miami-Dade County	Percent
Agriculture, forestry, fishing and hunting, and mining	9,929	0.8
Construction	103,636	8.0
Manufacturing	57,130	4.4
Wholesale trade	46,086	3.6
Retail trade	158,752	12.3
Transportation and warehousing and utilities	106,084	8.2
Information	23,941	1.9
Finance, insurance, real estate, rental, leasing	97,194	7.5
Professional, scientific, and administrative and waste management services	160,672	12.5
Educational services, and health care and social assistance	252,384	19.6
Arts, entertainment, recreation, accommodation and food services	149,588	11.6
Other services (except public administration)	79,895	6.2
Public administration	44,806	3.5
Total Employed Civilian Workers	1,290,097	

Source: USCB 2016a

Table 3-15 Estimated Income Information for Miami-Dade County and Florida (2016 Estimate)

	Miami-Dade County	Florida
Median household income (dollars)[a]	45,935	50,860
Per capita income (dollars)[a]	25,700	28,621
Families living below the poverty level (percent)	14.7	10.5
People living below the poverty level (percent)	18.3	14.7

[a] In 2016 inflation-adjusted dollars

Source: USCB 2016a

3.10.2.2 Unemployment

According to the USCB's 2016 American Community Survey 1-Year Estimates, the unemployment rate in Miami-Dade County was 5.9 percent (USCB 2016a). Comparatively, the unemployment rate in the State of Florida in 2016 was 6.0 percent (USCB 2016b).

3.10.3 Demographic Characteristics

An estimated 702,557 people live within 20 mi (32 km) of Turkey Point, which equates to an average population density of 559 persons per square mile (FPL 2018f). This translates to a Category 4, "Least sparse" population density using NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC 1996) measure of sparseness (greater than 120 persons per square mile within 20 mi). An estimated 3,472,804 people live within a 50-mi (80-km) radius of Turkey Point, which equates to an average population density of 442 persons per square mile. This translates to a Category 4, "In close proximity" measure of proximity (greater than 190 persons per square mile within 50 mi) using NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC 1996). Both a Category 4 measure of sparseness and proximity results in a "High" population category based on Figure C.1 of the license renewal GEIS sparseness and proximity matrix (NRC 1996). "High" population category corresponds to the least sparse population category and sites that are in close proximity to large cities. Therefore, Turkey Point is located in a "High" population area based on the license renewal GEIS sparseness and proximity matrix. As shown in Figure 3-1, Turkey Point is located on the coast and much of the area within a 50-mi (80-km) radius around the site consists of ocean and is unpopulated. Additionally, Everglades National Park, located west of the site, is unpopulated (EPA 2019). The population living within a 50-mi (80-km) radius of Turkey Point is primarily concentrated north, north-northeast, and north-northwest of Turkey Point.

Table 3-16 shows population percent growth and projections from 1990 to 2060 in Miami-Dade County. Over the last several decades, Miami-Dade County has experienced increasing population. Based on population projections, the population in Miami-Dade County is expected to continue to increase, but at a lower rate.

Table 3-16 Population and Percent Growth in Miami-Dade County 1990–2060

	Miami Dade County	
Year	Population	Percent Change Since Prior Entry
1990	1,937,094	–
2000	2,253,362	16.3
2010	2,496,435	10.8
2016	2,712,945	8.7[a]
2020	2,872,760	15.1[a]
2030	3,215,054	11.9
2040	3,477,569	8.2
2050	3,811,933	9.6
2060	4,127,087	8.3

[a] Percent change from 2010

Source: Decennial population data for 1970–2010 (USCB 1996, USCB 2000a, USCB 2010a); Estimated population for 2016 (USCB 2016b); Projected population for 2020–2040 (BEBR 2017); Calculated projected population for 2050–2060.

The 2010 Census demographic profile of the Miami-Dade County population is presented in Table 3-17. According to the 2010 Census (USCB 2010a), minorities (race and ethnicity combined) comprised approximately 85 percent of the total population. The largest minority population in Miami-Dade County was Hispanic or Latino of any race (65 percent of the total population; 77 percent of the total minority population). For comparison, according to the 2010 Census, minorities comprised approximately 42 percent of the total state of Florida population (USCB 2010b).

Table 3-17 Demographic Profile of the Population in Miami-Dade County in 2010

Miami-Dade County	
Total Population	2,496,435
Race (Percent of Total Population)	
White	73.8
Black or African American	18.9
American Indian and Alaska Native	0.2
Asian	1.5
Native Hawaiian and Other Pacific Islander	0
Some other race	3.2
Two or more races	2.4
Hispanic, Latino, or Spanish Ethnicity of Any Race	
Hispanic or Latino	1,623,589
Percent of total population	65.0
Minority Population (Including Hispanic or Latino Ethnicity)	
Total minority population	2,112,884
Percent minority	84.6

Source: USCB 2010a

According to the USCB's 2016 American Community Survey 1-Year Estimates, since 2010, minority populations in the Miami-Dade County were estimated to have increased by approximately 232,000 persons (see Table 3-18). The largest increases occurred in the Hispanic or Latino population (nearly 212,000 person increases since 2010, an increase of approximately 13 percent). According to the Census Bureau, minorities comprised 69 percent of the total Miami-Dade County population in 1990 (USCB 1990). By 2000, the county's minority population had increased to 79 percent of the population (USCB 2000b).

Table 3-18 Demographic Profile of the Population in Miami-Dade County, 2016 Estimates

Miami-Dade County	
Total Population	2,712,945
Race (Percent of Total Population)	
White	74.5
Black or African American	17.6
American Indian and Alaska Native	0.2
Asian	1.6

Miami-Dade County	
Native Hawaiian and Other Pacific Islander	0
Some other race	4.6
Two or more races	1.6
Hispanic, Latino, or Spanish Ethnicity of Any Race	
Hispanic or Latino	1,835,412
Percent of total population	67.8
Minority Population (Including Hispanic or Latino Ethnicity)	
Total minority population	2,344,897
Percent minority	86.4
Source: USCB 2016b	

3.10.3.1 Transient Population

Miami-Dade County can experience seasonal transient population growth as a result of local tourism, recreational activities, or university attendance. For instance, in 2017, Biscayne Bay National Park had approximately 447,000 visitors and Everglades National Park had approximately 1,019,000 visitors (NPS 2017a). In 2016, approximately 200,800 students were enrolled in college or graduate school in Miami-Dade County (USCB 2016c). A transient population creates a demand for temporary housing and services in the area.

Based on USCB's 2016 American Community Survey 1-Year Estimates (USCB 2016d), approximately 216,677 seasonal housing units are located in the four counties within a 50-mi (80-km) radius of Turkey Point (Miami-Dade, Monroe, Broward, and Collier counties). Of those, 66,528 seasonal housing units are located in Miami-Dade County. Table 3-19 presents information about seasonal housing for the counties all partly within the 50 mi (80 km) of Turkey Point. The Greater Miami Convention and Visitors Bureau estimates that in 2018, Miami-Dade County had 433 hotels/motels and approximately 55,450 rooms (GMCVB 2018).

Table 3-19 2016 Estimated Seasonal Housing in Counties Located Within 50 mi (80 km) of Turkey Point

County	Total Housing Units	Total Vacant Units	Vacant Housing Units: for Seasonal, Recreational, or Occasional Use	Percent Vacant Seasonal Housing Units
Miami-Dade	1,021,650	140,884	66,528	6.5
Monroe	53,129	22,811	14,854	27.5
Broward	822,980	141,506	78,911	9.6
Collier	210,147	70,625	56,384	26.8
Total	2,107,906	375,826	216,677	
Source: USCB 2016b and USCB 2016d				

3.10.3.2 Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these minority and low-income workers would be underrepresented in the decennial Census population counts.

Since 2002, the Census of Agriculture reports the numbers of farms hiring migrant workers—defined as a farm worker whose employment required travel that prevented the worker from returning to his/her permanent place of residence the same day (USDA 2012). The Census of Agriculture is conducted every 5 years and results in a comprehensive compilation of agricultural production data for every county and parish in the Nation.

Information about both migrant and temporary farm labor (persons working less than 150 days) can be found in the 2012 Census of Agriculture. Table 3-20 presents information on migrant and temporary farm labor in the four counties within a 50-mi radius of Turkey Point. According to the 2012 Census, 9,185 farm workers were hired to work for less than 150 days and were employed on 1,073 farms in the 4 counties within 50-mi of Turkey Point. The county with the highest number of temporary farm workers (4,480) on 63 farms was Collier County. Approximately 125 farms in the 4 counties within 50-mi of Turkey Point reported hiring approximately 3,590 migrant workers (USDA 2012).

Table 3-20 2012 Migrant Farm Workers and Temporary Farm Labor in Counties Located within 50 mi of Turkey Point

County	Number of Farms with Hired Farm Labor	Number of Farms Hiring Workers for Less Than 150 Days	Number of Farm Workers Working for Less Than 150 Days	Number of Farms Reporting Migrant Farm Labor
Miami-Dade	1,318	836	3,850	106
Monroe	15	7	83	-
Broward	234	167	772	7
Collier	104	63	4,480	12
Total	1,671	1,073	9,185	125

USDA 2012

3.10.4 Housing and Community Services

This section presents information regarding housing and local public services, including education and water supply.

3.10.4.1 Housing

Table 3-21 lists the total number of occupied and vacant housing units, the housing vacancy rates, and the median value of housing units in Miami-Dade County. Based on USCB's 2016 American Community Survey 1-year estimates (USCB 2016e), there were approximately

1,022,000 housing units in Miami-Dade County, of which approximately 881,000 were occupied. The median value of owner-occupied housing units is $265,200.

Table 3-21 Housing in Miami-Dade County (2016)

Miami-Dade County	
Total housing units	1,021,650
Occupied housing units	880,766
Total vacant housing units	140,884
Percent total vacant	13.8
Owner occupied units	446,018
Median value (dollars)	$265,200
Owner vacancy rate (percent)	1.9
Renter occupied units	434,748
Median rent (dollars/month)	1,201
Rental vacancy rate (percent)	5.2

Source: USCB 2016e

3.10.4.2 Education

The Miami-Dade County Public School District is comprised of 472 schools and approximately 354,000 students. The Miami-Dade County Public School District is the fourth largest school district in the United States (MDCPS 2018). The 2016–2017 Miami-Dade County Public School District total revenue was $4,232 million, of which approximately 59 percent was from local support (see discussion in Section 3.10.5, "Tax Revenues") (MDCPS 2017a).

3.10.4.3 Public Water Supply

The Miami-Dade Water and Sewer Department is the main public water supplier in Miami-Dade County. Miami-Dade County relies on groundwater withdrawn from the Biscayne aquifer and Floridian aquifer (see Section 3.5.2.1 for detailed discussion of these two major aquifer systems). Water is provided by the Miami-Dade Water and Sewer Department through four regional water treatment plants: Hialeah and John E. Preston Water Treatment Plant, the Hialeah Reverse Osmosis Water Treatment Plant, the Alexander Orr, Jr. Water Treatment Plant, and the South Dade Water Supply System (which is comprised of five smaller water treatment plants) (MDC 2014). The Newton Water Treatment Plant (part of the South Dade Water Supply System) serves Turkey Point. In addition to the Miami-Dade Water and Sewer Department, four water suppliers within Miami-Dade County provide water to parts of unincorporated Miami-Dade County and within their municipal boundaries: the City of North Miami, the City of North Miami Beach, Florida City, and City of Homestead. The capacity of wellfields and the water treatment plant facilities' installed capacity are presented in Table 3-22.

In 2013, the Miami-Dade Water and Sewer Department system population served was 2,222,944 and annual average daily demand was 302 mgd. Despite increases in population, water use has decreased between 2004 and 2013 by 16 percent. Decrease in water use has been attributed to Miami-Dade County's water use efficiency legislation and implementation of the County's water conservation plan (MDC 2014). According to the Miami-Dade Water Supply Facilities Work Plan (MDC 2014), when taking into consideration water conservation, by 2033, annual average daily water demand in the Miami-Dade Water and Sewer Department service area is projected to be 352 mgd (MDC 2014).

Table 3-22 Major Public Water Suppliers in Miami-Dade County

System Name	Wellfield Supply Capacity (mgd)	Installed Treatment Facility Capacity (mgd)	Population Served
City of North Miami	14.96	9.30	91,000
City of North Miami-Beach	39.97	32.0	164,000
City of Homestead	16.99	16.9	65,000
Florida City	4	4	9,700
Miami-Dade Water and Sewer Department Service Areas (Total)	634.01	497.19	2,223,000
Hialeah-Preston Treatment Plant	295	225	
Hialeah Reverse Osmosis Water Treatment Plant	12	10	
Alexander Orr, Jr. Water Treatment Plant	308	248	
South Dade Water Treatment Plants (5 plants) (Total)	19.01	14.19	
Elevated Tank	4.32	-	
Everglades Labor	5.04	-	
Leisure City	4.18	-	
Naranja	1.15	-	
Newton	4.32	-	

mgd: millions of gallons per day

Source: MDC 2014

3.10.5 Tax Revenues

The State of Florida does not have a State-level property tax. Private property owners pay property taxes to the county and a local school district and may also pay taxes to regional taxing districts. In Florida, real estate property and tangible personal property are subject to property tax. Property values are set by the county property appraiser and are collected by the county tax collector. The tax rate (millage) is set by each taxing unit. County and school district governments may levy taxes up to 10 mills ($10.00 per thousand of assessed valuation) each. As discussed below, FPL pays property taxes (real and tangible personal property) for Turkey Point to Miami-Dade County, the Miami-Dade School District, and several regional taxing districts (FPL 2018f).

The Miami-Dade County budget is comprised of appropriations from various revenues. The total Miami-Dade County operating revenues for the years 2012 through 2017 are presented in Table 3-23. Property taxes are a significant source of Miami-Dade County funding. For instance, property tax revenues have ranged from 23 to 33 percent of the total Miami-Dade County revenues between 2012 and 2017. Miami-Dade County property taxes fund four separate taxing jurisdictions: Countywide, Unincorporated Municipality Service Area, the Fire

Rescue District, and the Library System. Each of the four taxing jurisdictions is responsible for different types of services (MDC 2016b). For instance, the County-wide jurisdiction provides public health and social services, transportation, regional parks, and county roads, the court systems, and the regional sheriff services and jails. Additionally, Miami-Dade County also has a countywide debt and a Fire Rescue District debt millage. The revenue raised from the debt service millage pays outstanding debt for voter-approved general or special obligation bonds. The amount of property tax received by a taxing jurisdiction is a result of the millage rate applied by each county taxing jurisdiction. For 2017, the overall property tax millage rate was 9.7074 (MDC 2016b).

The Miami-Dade County Public School District is a taxing entity separate from Miami-Dade County. The Florida Education Finance Program is the primary mechanism for funding the operating costs of Florida school districts (FLDOE 2017). The Florida Education Finance Program allocates funds to the Miami-Dade County Public School District based on student enrollment (FHR 2010). Funding for school districts comes from State, local, and Federal sources. Local funding is obtained primarily from property taxes levied by Florida's counties, each of which constitutes a school district. Property taxes on properties located within the school district are levied after the millage rate is certified. Table 3-23 presents the Miami-Dade County School Board revenues for years 2012 through 2017. Property tax revenues provided approximately 45 to 52 percent of the total Miami-Dade County School Board revenues for years 2012 through 2017.

Miami-Dade County also imposes special district millage. These include the Children's Trust Authority, the Everglades Construction Project, the Okeechobee Basin, the South Florida Water Management District, and the Florida Inland Navigation District (SFWMD 2011a). Fiscal Year 2016–2017 total special district millage for Miami-Dade County was 0.3627 (MDC 2016c).

Table 3-23 Miami-Dade County Total Operating Revenues, Miami-Dade County School Board Revenues, and Florida Power & Light Turkey Point Property Tax Payments (2012–2017)

	2012	2013	2014	2015	2016	2017
Miami-Dade County Total Operating Revenues (in billions of dollars)	5.399	5.375	5.423	5.612	5.792	4.865
Miami-Dade County School Board Revenues (in billions of dollars)	3.222	3.302	3.524	3.581	3.631	3.729
Turkey Point total property tax paid (in millions of dollars)	6.653	29.613	40.594	38.995	37.882	36.570
Tax payment assigned to Miami-Dade County (percent of total Miami-Dade County Revenues)	3.446 (0.06)	15.280 (0.3)	21.108 (0.3)	20.394 (0.5)	20.229 (0.4)	19.858 (0.4)
Tax payment assigned to Miami-Dade County School District (percent of total Miami-Dade County School Board Revenues)	2.834 (0.08)	12.792 (0.4)	17.374 (0.5)	16.665 (0.5)	15.796 (0.4)	14.957 (0.4)
Tax payment assigned to special districts	0.372	1.629	2.070	1.911	1.856	1.755

Source: FPL 2018f, FPL 2018h, MDC 2015b, MDC 2016b, MDC 2017f, MDCPS 2017b

FPL pays property taxes (real and tangible personal property) for Turkey Point to Miami-Dade County, the Miami-Dade County Public School District, and several regional taxing districts (FPL 2018f). Turkey Point property tax payment for 2012–2017 are presented in Table 3-23.

The increase in property tax payment from 2012 to 2013 and from 2013 to 2014 is a result of plant modifications conducted to support an extended power uprate and the lien date (FPL 2018f and FPL 2018h). On June 15, 2012, the NRC granted a license amendment to FPL for an extended power uprate of Turkey Point (NRC 2012). Plant modifications and upgrades for the extended power uprate occurred in 2012 and 2013 and the valuation of the plant upgrades conducted in one year become taxable in the following year. This resulted in the Turkey Point property tax increases observed in 2013 and 2014. Turkey Point property tax payments to Miami-Dade County and Miami-Dade County Public School District have represented less than 1 percent of the Miami-Dade County revenue and of Miami-Dade County Public School District tax revenues. FPL does not expect there to be a notable or significant change to future property tax payments during the subsequent license renewal period (FPL 2018f).

In addition to property tax payments, FPL pays sales tax to Miami-Dade County for purchases. In 2017, FPL paid approximately $224,000 in sale taxes to Miami-Dade County from Turkey Point operation expenses (FPL 2018h). FPL also contributes $1.5 million annually to community organizations (FPL 2018h).

3.10.6 Local Transportation

The transportation network surrounding the Turkey Point site is comprised of U.S. highways, Interstate highways, local streets, and waterways. There are no ports or rail systems located within 6 mi (9.6 km) of the Turkey Point site. The nearest rail line, provided by CSX Corporation, is located approximately 10 mi (16 km) west of the Turkey Point site in Homestead, FL, and the Port of Miami is located approximately 23 mi (37 km) north of the site (CSX 2018). The NRC staff's EIS for the Turkey Point Units 6 and 7 combined license application (NUREG–2176) describes this transportation network in Section 2.5.2.3 (NRC 2016a); the NRC staff incorporates pages 2-175 through 2-178 of NUREG–2176 into this SEIS by reference.

Access to the Turkey Point site is via East Palm Drive (SW 344 St). East Palm Drive is a four-lane road that turns into a two-lane road at its intersection with Tallahassee Road (SW 137th Avenue) as it leads to the Turkey Point site. East Palm Drive intersects with US-1 approximately 8 mi from the Turkey Point Site. East Palm Drive provides access to the Homestead-Miami Speedway and Homestead Bayfront Park. Table 3-24 lists U.S. highways and roads near Turkey Point and their average annual daily traffic (AADT) volumes. The 2017 average annual daily reported two-way traffic volume for the monitoring site closest to Turkey Point on East Palm Drive was 9,800 vehicles.

Table 3-24 2017 Annual Average Daily Traffic in the Vicinity of Turkey Point

Location	Mile Marker	Average Annual Daily Traffic
Palm Drive (SW 344 St.)		
East of SW 132nd Ave Intersection	2.2	9,800
Intersection of Krome Ave (SW-177)	8.6	23,000
US-1 (South Dixie Highway)		
South of Palm Drive Intersection	0.3	32,500
S Krome Ave		
Intersection of Canal Dr (SW 328)	1.7	16,400

Source: FDOT 2017

3.11 <u>Human Health</u>

Turkey Point is both an industrial facility and a nuclear power plant. Similar to any industrial facility or nuclear power plant, the operation of Turkey Point Units 3 and 4 over the subsequent license renewal period will produce various human health risks for workers and members of the public. This section describes the human health risks resulting from the operation of Turkey Point Units 3 and 4, including from radiological exposure, chemical hazards, microbiological hazards, electromagnetic fields, and other hazards.

3.11.1 Radiological Exposure and Risk

Operation of a nuclear power plant involves the use of nuclear fuel to generate electricity. Through the fission process, the nuclear reactor splits uranium atoms resulting very generally in (1) the production of heat which is then used to produce steam to drive the plant's turbines and generate electricity and (2) the creation of radioactive byproducts. As required by NRC regulations at 10 CFR 20.1101, "Radiation protection programs," FPL designed a radiation protection program to protect onsite personnel (including employees and contractor employees), visitors, and offsite members of the public from radiation and radioactive material at Turkey Point.

The Turkey Point Units 3 and 4 radiation protection program is extensive and includes, but is not limited to, the following:

- Organization and Administration (e.g., a radiation protection manager who is responsible for the program and who ensures trained and qualified workers for the program)
- Implementing Procedures
- ALARA (as-low-as-is-reasonably-achievable) Program to minimize dose to workers and members of the public
- Dosimetry Program (i.e., measure radiation dose of plant workers)
- Radiological Controls (e.g., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements)
- Radiation Area Entry and Exit Controls (e.g., locked or barricaded doors, interlocks, local and remote alarms, personnel contamination monitoring stations)
- Posting of Radiation Hazards (i.e., signs and notices alerting plant personnel of potential hazards)
- Recordkeeping and Reporting (e.g., documentation of worker dose and radiation survey data)
- Radiation Safety Training (e.g., classroom training and use of mockups to simulate complex work assignments)
- Radioactive Effluent Monitoring Management (i.e., controlling and monitoring radioactive liquid and gaseous effluents released into the environment)
- Radioactive Environmental Monitoring (e.g., sampling and analysis of environmental media, such as direct radiation, air, water, groundwater, broad leaf vegetation, fish,

shellfish, and sediment to measure the levels of radioactive material in the environment that may impact human health)

- Radiological Waste Management (i.e., controlling, monitoring, processing, and disposing of radioactive solid waste)

Regarding radiation exposure to Turkey Point Units 3 and 4 personnel, the NRC staff reviewed the data contained in NUREG–0713, Volume 38, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities 2016: Forty-Ninth Annual Report" (NRC 2018h). The forty-ninth annual report was the most recent annual report available at the time of this environmental review. It summarizes the NRC's Radiation Exposure Information and Reporting System database's occupational exposure data through 2016. Nuclear power plants are required by 10 CFR 20.2206, "Reports of individual monitoring," to report their occupational exposure data to the NRC annually. Chapter 4, "Environmental Consequences and Mitigating Actions," in this SEIS includes further discussion of radiological doses associated with the Turkey Point Units 3 and 4 subsequent license renewal.

NUREG–0713 calculates a 3-year average collective dose per reactor for workers at all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the applicant's ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material over a 1-year time period. There are no NRC or EPA standards for collective dose. Based on the data for operating pressurized-water reactors like the ones at Turkey Point Units 3 and 4, the average annual collective dose per reactor was 42 person-rem. In comparison, Turkey Point Units 3 and 4 had a reported annual collective dose per reactor of 45 person-rem.

In addition, as reported in NUREG–0713, for 2016, no worker at Turkey Point Units 3 and 4 received an annual dose greater than 0.75 rem (0.0075 sievert (Sv)), which is much less than the NRC occupational dose limit of 5.0 rem (0.05 Sv) in 10 CFR 20.1201, "Occupational dose limits for adults."

Offsite dose to members of the public is discussed in Section 3.1.4, "Radioactive Waste Management Systems," of this SEIS.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like Turkey Point manage minor chemical spills. Chemical and hazardous wastes can potentially impact workers, members of the public, and the environment.

FPL currently controls the use, storage, and discharge of chemicals and sanitary wastes at Turkey Point Units 3 and 4 in accordance with its chemical control procedures, waste-management procedures, and Turkey Point site-specific chemical spill prevention plans. FPL monitors and controls discharges of chemical and sanitary wastes through Turkey Point Unit 3 and 4's National Pollutant Discharge Elimination System permit process. These plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize impact to workers, members of the public, and the environment (FPL 2018f).

3.11.3 Microbiological Hazards

Nuclear power plants that discharge thermal effluents to cooling ponds, lakes, canals, or rivers have the potential to promote the increased growth of thermophilic microorganisms, which could result in adverse health effects for plant workers and the public. Microorganisms of particular concern include several types of bacteria (*Legionella* spp., *Salmonella* spp., *Shigella* spp., and *Pseudomonas aeruginosa*) and the free-living amoeba *Naegleria fowleri*, all of which require freshwater environments. Because Turkey Point withdraws from and discharges to the CCS, which is a saline environment, the above freshwater microorganisms are not a concern at Turkey Point, and this SEIS provides no further discussion of them. Section 3.9.3.1 of the license renewal GEIS (NUREG–1437) (NRC 2013a) provides additional background information on these microorganisms.

3.11.4 Electromagnetic Fields

Based on its evaluation in the license renewal GEIS (NUREG–1437), the NRC has not found electric shock resulting from direct access to energized conductors or from induced charges in metallic structures to be a problem at most operating plants. Generally, the NRC staff also does not expect electric shock from such sources to be a human health hazard during the subsequent license renewal period. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS. Transmission lines that are within the scope of the NRC's subsequent license renewal environmental review are limited to: (1) those transmission lines that connect the nuclear plant to the substation where electricity is fed into the regional distribution system and (2) those transmission lines that supply power to the nuclear plant from the grid (NRC 2013a).

As discussed in Section 3.1.6.5, "Power Transmission Systems," of this SEIS, the only transmission lines that are in scope for Turkey Point subsequent license renewal are onsite. Specifically, these onsite, in-scope transmission lines are approximately 590 feet (180 m) and connect Units 3 and 4 to the onsite 230-kV switchyard (FPL 2018f). Therefore, there is no potential shock hazard to offsite members of the public from these onsite transmission lines. As discussed in Section 3.11.5, "Other Hazards," of this SEIS, Turkey Point maintains an occupational safety program, which includes protection from acute electrical shock, and is in accordance with Occupational Safety and Health Administration regulations.

3.11.5 Other Hazards

This section addresses two additional human health hazards: (1) physical occupational hazards and (2) occupational electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation utility. Nuclear power plant workers may perform electrical work, electric power line maintenance, repair work, and maintenance activities and may be exposed to some potentially hazardous physical conditions (e.g., falls, excessive heat, cold, noise, electric shock, and pressure).

The Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. Congress created OSHA by enacting the Occupational Safety and Health Act of 1970, as amended (29 U.S.C. 651 et seq.) to safeguard the health of workers. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC as set forth in a memorandum of understanding (NRC 2013f) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur. Turkey Point Units 3 and 4 maintain an occupational safety program for its workers in accordance with OSHA regulations (FPL 2018f).

3.12 Environmental Justice

Under Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629), Federal agencies are responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Independent agencies, such as the NRC, are not bound by the terms of EO 12898 but are, as stated in paragraph 6-604 of the executive order, "requested to comply with the provisions of [the] order." In 2004, the Commission issued the agency's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040), which states, ""The Commission is committed to the general goals set forth in [EO] 12898, and strives to meet those goals as part of its NEPA review process."

The Council on Environmental Quality (CEQ) provides the following information in its publication "Environmental Justice: Guidance Under the National Environmental Policy Act" (CEQ 1997):

> *Disproportionately High and Adverse Human Health Effects.*
>
> Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997).
>
> *Disproportionately High and Adverse Environmental Effects.*
>
> A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ 1997).

This environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the operation of Turkey Point Units 3 and 4 during the subsequent license renewal period of extended operation. In assessing the impacts, the NRC staff used the following definitions of minority individuals, minority populations, and low-income population (CEQ 1997):

> *Minority Individuals*
>
> Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races, meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, White and Asian. In other words, everyone except persons who identified themselves as White, Not Hispanic or Latino are considered minority.
>
> *Minority Populations*
>
> Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.
>
> *Low-income Population*
>
> Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P60, on Income and Poverty.

In determining the location of minority and/or low-income populations, the geographic area used to perform a comparative analysis is a 50-mi (80-km) radius from the facility. The 50-mi (80-km) radius is consistent with the impact analysis conducted for human health impacts. The percentage of minority and/or low-income populations in the 50-mi geographic area is compared to the percentage of minority and/or low-income populations in each census block group to determine which block groups exceeds the percentage, thereby identifying the location of these populations (NRC 2013c).

<u>Minority Population</u>

According to the Census Bureau's 2010 Census data, there are a total 2,152 block groups, and approximately 78 percent of the population residing within a 50-mi (80-km) radius of Turkey Point identified themselves as minority individuals (USCB 2010b). The largest minority populations were Hispanic or Latino of any race (approximately 55 percent) followed by Black or African American (approximately 19 percent).

According to the Council on Environmental Quality guidance, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. In this SEIS, the NRC staff's environmental justice analysis applied the meaningfully greater threshold in identifying higher concentrations of minority populations. The meaningfully greater threshold is any percentage greater than the minority population within the 50-mi radius. Therefore, for the purposes of identifying higher concentrations of minority populations, census block groups within the 50-mi (80-km) radius of Turkey Point were identified as minority population block groups if the percentage of the minority population in the block group exceeded

78 percent, which is the percent of the minority population within the 50-mi (80-km) radius of Turkey Point.

As shown in Figure 3-23, minority population block groups are notable and located throughout the 50-mi (80-km) radius of Turkey Point. Based on this analysis, there are 1,247 minority population block groups (using the "meaningfully greater" threshold of 78 percent minority population) within the 50-mi (80-km) radius of Turkey Point and minority population block groups are clustered around the cities of Miami, Miramar, Miami-Gardens, Hialeah, Homestead, Florida City, and the Everglades census county subdivision. Turkey Point is located in a minority population block group.

As presented in Section 3.10, "Socioeconomics," of this SEIS, in 2010, the minority population in Miami-Dade County was approximately 85 percent and the minority population in the State of Florida was approximately 42 percent. According to the Census Bureau's 2016 American Community Survey 1-Year Estimates, since 2010, minority populations in Miami-Dade County have increased by approximately 232,000 persons. The largest increases occurred in the Hispanic or Latino population (nearly 212,000 person increases since 2010, an increase of approximately 13 percent).

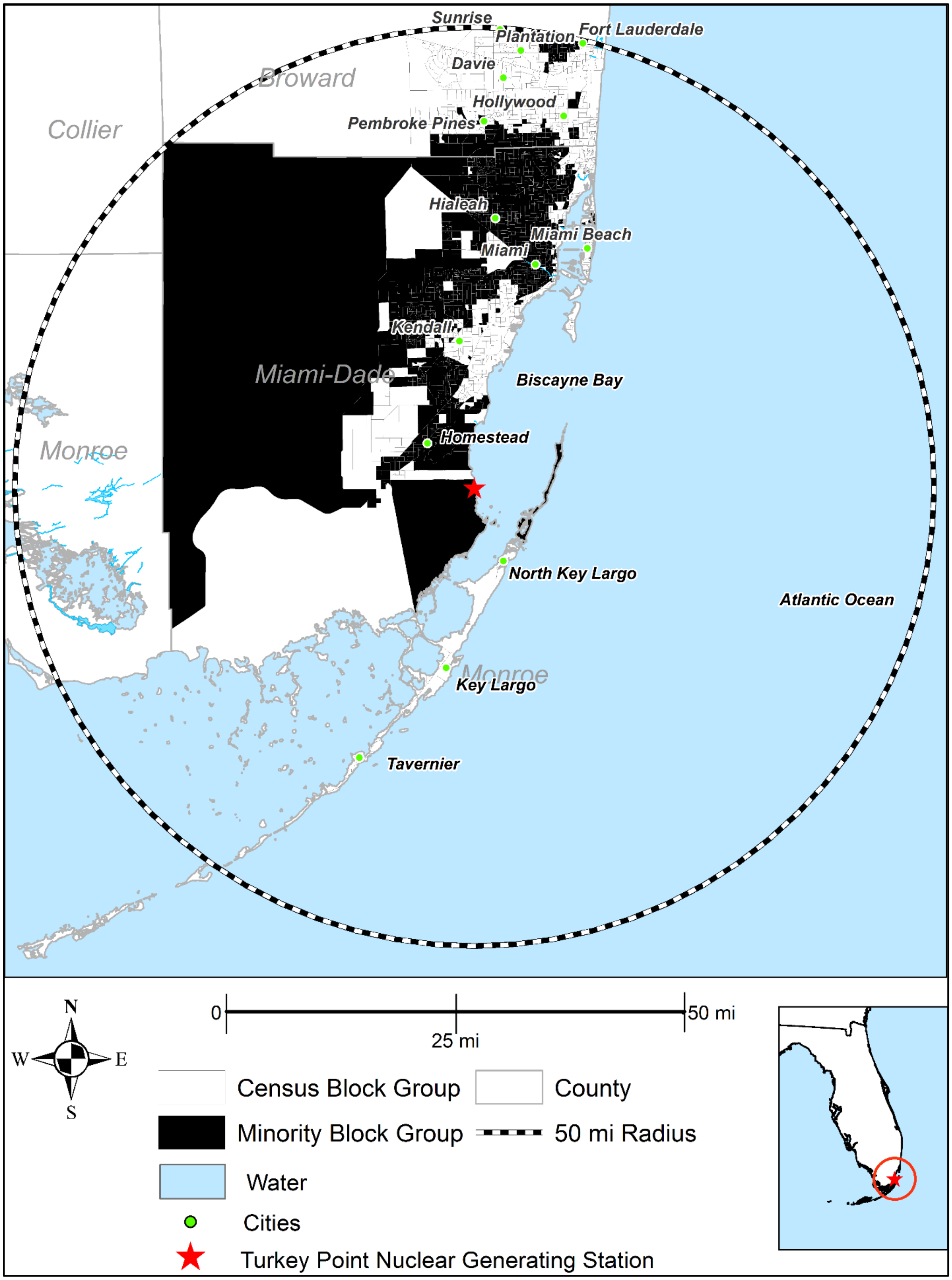
<u>Low-Income Population</u>

The Census Bureau's 2012–2016 American Community Survey data identify approximately 18 percent of individuals residing within a 50-mi (80-km) radius of Turkey Point as living below the Federal poverty threshold (USCB 2016f). The 2016 Federal poverty threshold was $24,563 for a family of four (USCB 2016g).

Figure 3-24 shows the location of predominantly low-income population block groups within a 50-mi (80-km) radius of Turkey Point. In accordance with NRC guidance (NRC 2013a), census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within the block group exceeded 18 percent, which is the percent of the individuals living below the Federal poverty threshold within the 50-mi (80-km) radius of Turkey Point.

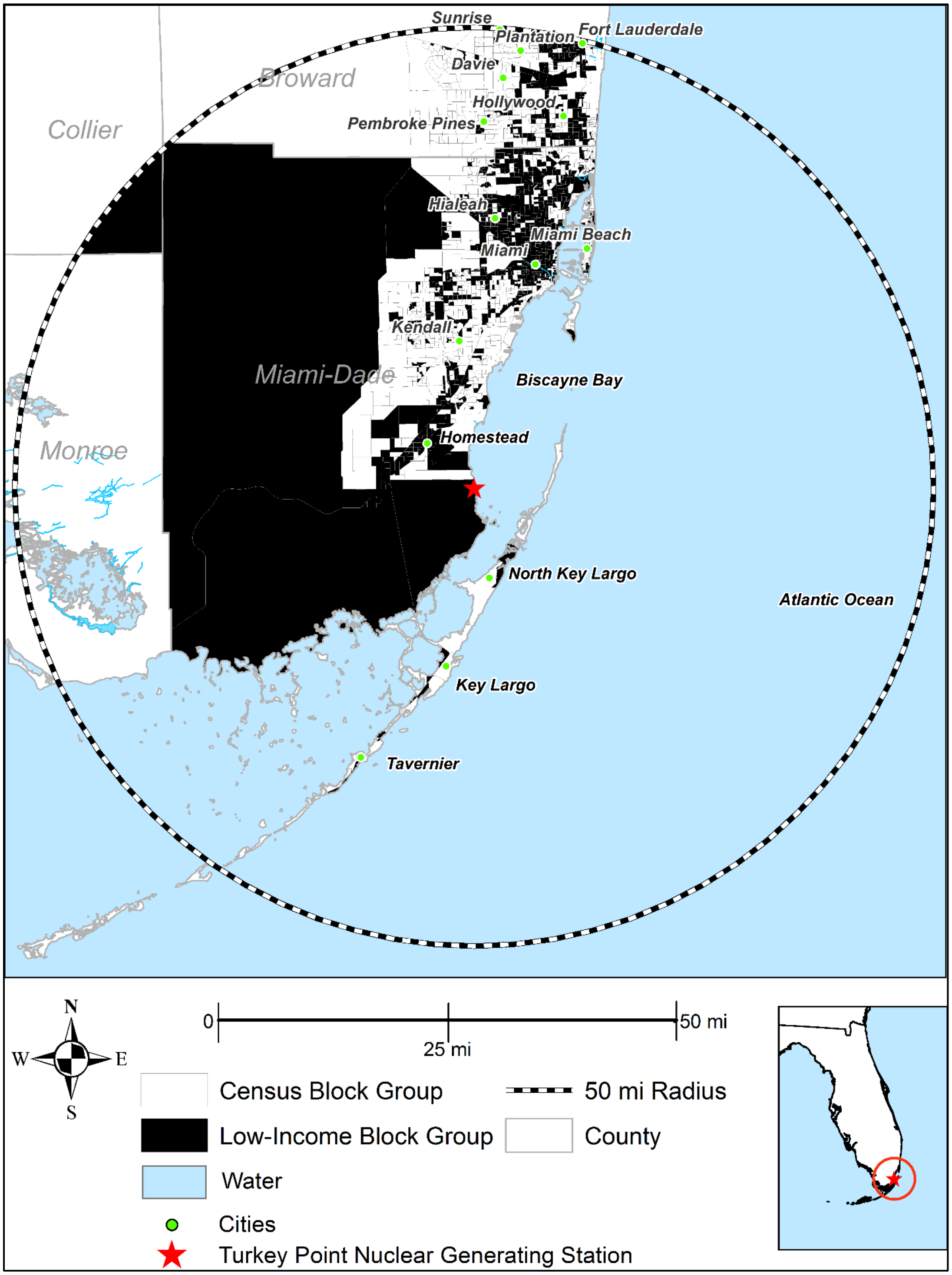
As shown in Figure 3-24, low income population block groups are clustered in the cities of Miami, Hialeah, and Fort Lauderdale, and in the Everglades and Homestead census county subdivisions. Based on this analysis, there are 1,010 low-income population block groups (approximately 50 percent of the block groups within 50 mi (80 km) of Turkey Point) and Turkey Point is located in a low-income population block group.

As presented in Table 3-15, people living in Miami-Dade County (the socioeconomic region of influence) have lower median household and per capita incomes than average for the State of Florida and a higher percentage of families and people living below the poverty level.



Source: USCB 2010b

Figure 3-23 2010 Census—Minority Block Groups Within a 50-mi (80-km) Radius of Turkey Point



1 Source: USCB 2016f

2 **Figure 3-24 2012–2016, American Community Survey 5-Year Estimates—Low-Income**
3 **Block Groups Within a 50-mi (80-km) Radius of Turkey Point**

3.13 Waste Management and Pollution Prevention

Like any operating nuclear power plant, Turkey Point Units 3 and 4 will produce both radioactive and nonradioactive waste during the subsequent license renewal period. This section describes waste management and pollution prevention at Turkey Point.

3.13.1 Radioactive Waste

As discussed in Section 3.1.4, "Radioactive Waste Management Systems," of this SEIS, Turkey Point uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of plant operations. Radioactive materials in liquid and gaseous effluents are reduced prior to being released into the environment so that the resultant dose to members of the public from these effluents is well within NRC and EPA dose standards. Radionuclides that can be efficiently removed from the liquid and gaseous effluents prior to release are converted to a solid waste form for disposal in a licensed disposal facility.

3.13.2 Nonradioactive Waste

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101-508) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94-580) (NRC 2013a).

As described in Section 3.1.5, "Nonradioactive Waste Management System," Turkey Point has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. Turkey Point maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

Turkey Point has a Stormwater Pollution Prevention Plan that identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The Stormwater Pollution Prevention Plan also describes best management practices for reducing pollutants in stormwater discharges and assure compliance with the site's Florida Department of Environmental Protection permit.

Turkey Point also has a Spill Prevention, Control, and Countermeasure (SPCC) plan (see FPL's environmental report for subsequent license renewal, Section 9.5.3.6) to monitor areas within the site that have the potential to discharge oil into or upon navigable waters, in accordance with the regulations in 40 CFR Part 112, "Oil Pollution Prevention." The SPCC plan identifies and describes the procedures, materials, equipment, and facilities that FPL uses to minimize the frequency and severity of oil spills at Turkey Point.

Turkey Point is subject to EPA reporting requirements in 40 CFR Part 110, "Discharge of Oil," pursuant to Section 311(b)(4) of the Federal Water Pollution Control Act. Under these regulations, FPL must report to the National Response Center any discharges of oil if the quantity may be harmful to the public health or welfare or to the environment. From 2012 through 2016, FPL reported no oil discharges that triggered the EPA's reporting requirements in 40 CFR Part 110.

Turkey Point is also subject to the reporting provisions of the Florida Administrative Code (FAC) at 62-780.210, Contamination Reporting, concerning the discovery of petroleum or petroleum products contamination or a discharge of petroleum or petroleum products, as well as other FAC reporting requirements. Thus, the NRC staff expects that petroleum and petroleum product spills would be reported to the appropriate regulatory authority.

The NRC staff issued two requests for additional information to FPL regarding reportable spills at Turkey Point. In the first request, the NRC staff asked FPL to provide additional information to the NRC as to whether there have been any reportable spills (discharge of oil) that may be harmful, pursuant to Section 311(b)(4) of the Federal Water Pollution Control Act, that occurred after FPL wrote and submitted its environmental report for the subsequent license renewal application. In its August 2018 response (FPL 2018b, NRC RAI Number: WM-1), FPL stated that “based on the listing of calls received by the U.S. Coast Guard National Response Center, there have been no reportable spills triggering the 40 CFR Part 110 notification requirement at Turkey Point since the ER was written” (USCG 2018).

In its second request for additional information on reportable spills, the NRC staff asked FPL to provide additional information to the NRC as to whether, after the environmental report was written, there have been any reportable spills (discharge of oil) at Turkey Point that may have had the potential to significantly pollute surface waters or groundwater and which were not confined to a building or similar structure. FPL stated in its August 2018 response (FPL 2018g, NRC RAI Number: WM-2) that “there have been no reportable spills since the ER was submitted.”

4 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

4.1 Introduction

In this chapter, the U.S. Nuclear Regulatory Commission (NRC) staff evaluates the environmental consequences of issuing subsequent renewed licenses authorizing an additional 20 years of operation for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4). The NRC staff's evaluation of environmental consequences includes the following:

1) impacts associated with continued operations similar to those impacts that have occurred during the current renewed license term
2) impacts of various alternatives to the proposed action, including a no-action alternative (not issuing the subsequent renewed licenses) and replacement power alternatives (new nuclear; natural gas combined-cycle; and a combination of natural gas and solar power)
3) impacts from the termination of nuclear power plant operations and decommissioning after the subsequent license renewal term (with emphasis on the incremental effect caused by an additional 20 years of reactor operation)
4) impacts associated with the uranium fuel cycle
5) impacts of postulated accidents (design-basis accidents and severe accidents)
6) cumulative impacts of the proposed action of issuing subsequent renewed licenses for Turkey Point
7) resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources
8) new and potentially significant information on environmental issues related to the impacts of operation during the subsequent license renewal term

In this chapter, the NRC staff also compares the environmental impacts of subsequent license renewal with the environmental impacts of the no-action alternative and replacement power alternatives to determine whether the adverse environmental impacts of subsequent license renewal are so great that it would be unreasonable to preserve the option of subsequent license renewal for energy-planning decisionmakers. Chapter 2, "Alternatives Including the Proposed Action," of this supplemental environmental impact statement (SEIS) describes in detail the attributes of the proposed action (subsequent license renewal of Turkey Point) and the no-action alternative. Chapter 2, Section 2.2.2, "Replacement Power Alternatives," further describes the NRC staff's process for developing a range of reasonable alternatives to the proposed action and the replacement power alternatives that the staff selected for detailed analysis in this chapter, including supporting assumptions and data. As noted in Chapter 2, Table 2.1, the site location for various replacement power alternatives would be adjacent to Turkey Point Units 3 and 4. Chapter 2, Table 2.2, summarizes the environmental impacts of the proposed action and alternatives to the proposed action.

The affected environment (i.e., environmental baseline) for each resource area considered, and against which the potential environmental impacts of the alternatives are measured, is described in Chapter 3, “Affected Environment.” As documented in Chapter 3, the effects of ongoing reactor operations at Turkey Point have become well established as environmental conditions have adjusted to and reflect the presence of the nuclear power plant.

This SEIS documents the NRC staff’s environmental review of the Turkey Point subsequent license renewal application and supplements the information in NUREG–1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (also known as the 2013 GEIS) (NRC 2013a). The 2013 GEIS identifies 78 issues (divided into Category 1 and Category 2 issues) to be evaluated for the proposed action in the environmental review process. Section 1.4, “Generic Environmental Impact Statement,” of this SEIS provides an explanation of the criteria for Category 1 issues (i.e., those issues generic to all nuclear power plants or a distinct subset of plants) and Category 2 issues (i.e., those issues specific to individual nuclear power plants) as well as the definitions of SMALL, MODERATE, and LARGE impact significance.

For Category 1 issues, the NRC staff can rely on the analysis in the GEIS unless otherwise noted. Table 4-1 lists the Category 1 (generic) issues that apply to Turkey Point during the proposed subsequent license renewal period. For each Category 1 issue, the NRC staff considered whether there is any new and significant information that might alter the conclusions reached in the GEIS for that issue. As discussed in Section 4.14 of this SEIS, Regulatory Guide (RG) 4.2, Supplement 1, “Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications” (NRC 2013b), defines “new and significant information” as (1) information that identifies a significant environmental impact issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, in Appendix B to Subpart A of 10 CFR Part 51, or (2) information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1. For most issues, the NRC staff did not identify any new and significant information during its review of Florida Power & Light Company’s (FPL’s) environmental report, the site audits, or the scoping period that would change the conclusions in the GEIS. Therefore, there are no impacts related to those Category 1 issues beyond those already discussed in the GEIS. The staff’s process for evaluating new and significant information is described in Section 4.14, “Evaluation of New and Significant Information.”

The NRC staff identified and evaluated new information for two existing Category 1 issues (i.e., groundwater quality degradation (plants with cooling ponds in salt marshes) and cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)) and identified one new issue (i.e., water quality impacts on adjacent water bodies (plants with cooling ponds in salt marshes)). The NRC staff’s evaluation of these three issues is presented in Sections 4.5.1.1, 4.5.1.2, and 4.6.1 of this SEIS.

Table 4-1 Applicable Category 1 (Generic) Issues for Turkey Point

Issue	GEIS Section	Impact
Land Use		
Onsite land use	4.2.1.1	SMALL
Offsite land use	4.2.1.1	SMALL

Issue	GEIS Section	Impact
Visual Resources		
Aesthetic impacts	4.2.1.2	SMALL
Air Quality		
Air quality impacts (all plants)	4.3.1.1	SMALL
Air quality effects of transmission lines	4.3.1.1	SMALL
Noise		
Noise impacts	4.3.1.2	SMALL
Geologic Environment		
Geology and soils	4.4.1	SMALL
Surface Water Resources		
Surface water use and quality (non-cooling system impacts)	4.5.1.1	SMALL
Discharge of metals in cooling system effluent	4.5.1.1	SMALL
Discharge of biocides, sanitary wastes, and minor chemical spills	4.5.1.1	SMALL
Effects of dredging on surface water quality	4.5.1.1	SMALL
Groundwater Resources		
Groundwater contamination and use (non-cooling system impacts)	4.5.1.2	SMALL
Groundwater quality degradation resulting from water withdrawals	4.5.1.2	SMALL
Groundwater quality degradation (plants with cooling ponds in salt marshes)[a]	4.5.1.2	SMALL[b]
Terrestrial Resources		
Exposure of terrestrial organisms to radionuclides	4.6.1.1	SMALL
Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)[a]	4.6.1.1	SMALL
Bird collisions with plant structures and transmission lines	4.6.1.1	SMALL
Transmission line right-of-way management impacts on terrestrial resources[c]	4.6.1.1	SMALL
Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.6.1.1	SMALL
Aquatic Resources		
Entrainment of phytoplankton and zooplankton (all plants)	4.6.1.2	SMALL
Infrequently reported thermal impacts (all plants)	4.6.1.2	SMALL
Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication	4.6.1.2	SMALL
Effects of non-radiological contaminants on aquatic organisms	4.6.1.2	SMALL
Exposure of aquatic organisms to radionuclides	4.6.1.2	SMALL
Effects of dredging on aquatic resources	4.6.1.2	SMALL
Effects on aquatic resources (non-cooling system impacts)	4.6.1.2	SMALL
Impacts of transmission line right-of-way management on aquatic resources[c]	4.6.1.2	SMALL
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.6.1.2	SMALL
Socioeconomics		
Employment and income, recreation and tourism	4.8.1.1	SMALL
Tax revenues	4.8.1.2	SMALL

Issue	GEIS Section	Impact
Community services and education	4.8.1.3	SMALL
Population and housing	4.8.1.4	SMALL
Transportation	4.8.1.5	SMALL
Human Health		
Radiation exposures to the public	4.9.1.1.1	SMALL
Radiation exposures to plant workers	4.9.1.1.1	SMALL
Human health impact from chemicals	4.9.1.1.2	SMALL
Microbiological hazards to plant workers	4.9.1.1.3	SMALL
Physical occupational hazards	4.9.4.1.5	SMALL
Postulated accidents		
Design-basis accidents	4.9.1.2	SMALL
Waste Management		
Low-level waste storage and disposal	4.11.1.1	SMALL
Onsite storage of spent nuclear fuel	4.11.1.2	SMALL
Offsite radiological impacts of spent nuclear fuel and high-level waste disposal	4.11.1.3	(d)
Mixed-waste storage and disposal	4.11.1.4	SMALL
Nonradioactive waste storage and disposal	4.11.1.4	SMALL
Uranium Fuel Cycle		
Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	SMALL
Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	(e)
Nonradiological impacts of the uranium fuel cycle	4.12.1.1	SMALL
Transportation	4.12.1.1	SMALL
Termination of Nuclear Power Plant Operations and Decommissioning		
Termination of plant operations and decommissioning	4.12.2.1	SMALL

Issue	GEIS Section	Impact

[(a)] The environmental impact of this issue includes consideration of site-specific new information for Turkey Point.

[(b)] The NRC staff recognizes that the current impacts on this issue are greater than SMALL (i.e., the impacts are MODERATE). However, as discussed in Section 4.5.1.2 of this chapter, in response to a 2015 consent agreement with the Miami-Dade County Department of Environmental Resource Management (DERM) (MDC 2015a) and a 2016 consent order from the Florida Department of Environmental Protection (FDEP) (FDEP 2016e), FPL has implemented a recovery well system to halt and retract the hypersaline plume and to abate and remediate the effects of the hypersaline plume from the cooling canal system. These efforts are expected to remediate the hypersaline plume prior to the commencement of the subsequent license renewal term. In addition, FPL's actions to remediate the plume are subject to continued regulatory oversight by the DERM and the FDEP. Therefore, the NRC staff expects that groundwater quality degradation impacts resulting from subsequent license renewal will be SMALL.

[(c)] This issue applies only to the in-scope portion of electric power transmission lines, which are defined as transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid.

[(d)] The environmental impact of this issue for the time frame beyond the licensed life for reactor operations is contained in NUREG–2157, the NRC's "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NRC 2014c).

[(e)] There are no regulatory limits applicable to collective doses to the general public from fuel-cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel-cycle facilities are designed and operated to meet the applicable regulatory limits and standards. The Commission concludes that the collective impacts are acceptable. The Commission concludes that the impacts would not be sufficiently large to require the National Environmental Policy Act (NEPA) conclusion, for any plant, that the option of extended operation under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective impacts of the uranium fuel cycle, this issue is considered Category 1.

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 and NRC 2013a

The NRC staff analyzed the Category 2 (site-specific) issues applicable to Turkey Point during the proposed subsequent license renewal period and assigned impacts to these issues as shown below in Table 4-2.

Table 4-2 Applicable Category 2 (Site-Specific) Issues for Turkey Point

Issue	GEIS Section	Impact[(a)]
Groundwater Resources		
Groundwater use conflicts (plants that withdraw more than 100 gallons per minute (gpm))	4.5.1.2	SMALL to MODERATE
Radionuclides released to groundwater	4.5.1.2	SMALL
Terrestrial Resources		
Effects on terrestrial resources (non-cooling system impacts)	4.6.1.1	SMALL
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	SMALL to MODERATE[(b)]

Issue	GEIS Section	Impact[(a)]
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	SMALL to MODERATE[(b)]
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	4.6.1.3	Impact determinations vary by species and habitat[(c)]
Historic and Cultural Resources		
Historic and cultural resources	4.7.1	would not adversely affect known historic properties or historic and cultural resources
Human Health		
Chronic effects of electromagnetic fields[(d)]	4.9.1.1.1	Uncertain Impact
Electric shock hazards	4.9.1.1.1	SMALL
Postulated Accidents		
Severe accidents	4.9.1.2	SMALL
Environmental Justice Minority and low-income populations	4.10.1	no disproportionately high and adverse human health and environmental effects
Cumulative Impacts		
Cumulative impacts	4.13	See SEIS Section 4.16

(a) Impact determinations for Category 2 issues are based on findings described in Sections 4.2 through 4.13 of this SEIS for the proposed action.

(b) The conclusion of "SMALL to MODERATE" applies to aquatic resources in the cooling canal system. Aquatic organisms inhabiting Biscayne Bay and connected waterbodies (e.g., Card Sound, the Atlantic Ocean) are not subject to impingement and entrainment because they do not interact with the Turkey Point intake structure, and there are no thermal effects outside the cooling canal system because there are no surface water connections that allow flow between the waters of Biscayne Bay and the cooling canal system.

(c) The NRC staff concludes that Turkey Point subsequent license renewal is likely to adversely affect the American crocodile and the eastern indigo snake, and may result in adverse modification to designated critical habitat of the American crocodile. The proposed action may affect, but is not likely to adversely affect, the Florida bonneted bat, Florida panther, West Indian manatee, red knot, piping plover, wood stork, Everglades snail kite, Kirtland's warbler, Blodgett's silverbush, Cape Sable thoroughwort, Florida semaphore cactus, sand flax, Florida bristle fern, loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and smalltooth sawfish. The proposed action would result in no adverse modification to designated critical habitat of the West Indian manatee. The proposed action would have no adverse effects on Essential Fish Habitat. The NRC staff's evaluation of impacts to species and habitats under the U.S. Fish and Wildlife Service's jurisdiction can be found in the NRC's Biological Assessment (NRC 2018n). The evaluation of impacts to species and habitats under the National Marine Fisheries Service's jurisdiction can be found in Section 4.8 of this SEIS.

(d) This issue was not designated as Category 1 or Category 2 and is discussed in Section 4.11.1, "Proposed Action."

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 and NRC 2013a

4.2 Land Use and Visual Resources

This section describes the potential land use and visual resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.2.1 Proposed Action

According to the GEIS (NRC 1996 and NRC 2013a), land use and visual resources would not be affected by continued operations and refurbishment associated with license renewal. In addition, nuclear plant operations at Turkey Point have not changed appreciably with time, and no change in land use and visual resources impacts are expected during the subsequent license renewal term. The NRC staff identified no new or significant information for these issues.

In this regard, no new or significant information was identified during the review of FPL's environmental report, the NRC staff's site visit, the scoping process, or the evaluation of other available information. The communities in the vicinity of Turkey Point have pre-established patterns of development and have adequate public services to support and guide development. Consequently, people living in the vicinity of Turkey Point would not experience any land use or visual changes during the subsequent license renewal term beyond what has already been experienced. In addition, no adverse effects on offsite land use will occur related to the Everglades Restoration Project (conducted under the Comprehensive Everglades Restoration Plan (CERP)) or other Federal action in the proposed project area. Therefore, the land use and visual impacts of continued reactor operations during the subsequent license renewal term would not exceed the land use and visual impacts predicted in the GEIS. For these issues, the GEIS predicted that the impacts would be SMALL for all nuclear plants.

As identified in Table 4-1, the impacts of all generic land use or visual resource issues would be SMALL. Table 4-2 does not identify any site-specific (Category 2) land use or visual resource issues.

4.2.2 No-Action Alternative

4.2.2.1 Land Use

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point Units 3 and 4 would shut down on or before the expiration of the current renewed operating licenses (i.e., 2032 and 2033). Under this alternative, land uses would remain similar to those that would occur under the proposed subsequent license renewal except that land could be converted to other uses sooner if Turkey Point is shut down in 2032 and 2033 instead of operating for an additional 20 years. Shutdown of Turkey Point under the no-action alternative thus would not affect onsite land use. Plant structures and other facilities would remain in place until decommissioning. Most transmission lines would remain in service after the plant stops operating. Maintenance of most existing infrastructure would continue as before. Therefore, land use impacts from the termination of Turkey Point Unit Nos. 3 and 4 nuclear plant operations would be SMALL.

4.2.2.2 Visual Resources

Shutdown of Turkey Point under the no-action alternative would not significantly change the visual appearance of the Turkey Point site. At the Turkey Point site, the reactor and turbine buildings are the buildings that create the largest visual impact. Under the no-action alternative, the reactor and turbine buildings would likely remain in place for some time but would eventually be dismantled. This would reduce the visual impact. Overall, visual impacts from the termination of Turkey Point Unit Nos. 3 and 4 nuclear plant operations would be SMALL.

4.2.3 Replacement Power Alternatives: Common Impacts

4.2.3.1 Land Use

The NRC staff's analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a replacement power plant.

<u>Construction</u>

Construction would require the permanent commitment of land zoned for industrial use at the Turkey Point site for replacement power plants and associated infrastructure. Existing Turkey Point transmission lines and infrastructure would adequately support each of the replacement power alternatives, thus reducing the need for additional land commitments.

<u>Operations</u>

Operation of new power plants would have no land use impacts beyond land committed for the permanent use of the replacement power plant. Additional land may be required to support power plant operations including land for mining, extraction, and waste disposal activities associated with each alternative.

4.2.3.2 Visual Resources

The NRC staff's visual impact analysis focuses on the degree of contrast between the replacement power plant and the surrounding landscape and the visibility of the new power plant.

<u>Construction</u>

Land for any replacement power plant would require clearing, excavation, and the use of construction equipment. Temporary visual impacts may occur during construction from cranes and other construction equipment.

<u>Operations</u>

Visual impacts during plant operations of any of the replacement power alternatives would be similar in type and magnitude. New cooling towers (if built) and their associated plumes would be the most obvious visual impact and would likely be visible farther from the site than other buildings and infrastructure. New plant stacks may require aircraft warning lights, which would be visible at night.

4.2.4 New Nuclear Alternative

4.2.4.1 Land Use

Construction

Approximately 360 acres (ac) (150 hectares (ha)) of land would be needed to construct a new nuclear power plant. Although there is sufficient land available at the Turkey Point site, some wetlands may be temporarily displaced during construction. Land use impacts during construction would be SMALL at the Turkey Point site since the land is already zoned for industrial use.

Operations

Offsite land use impacts associated with uranium mining and fuel fabrication needed to support nuclear power plant operations would generally be no different from the amount of land needed to support Turkey Point Units 3 and 4 operations, although more land would be required for mining additional uranium for up to 40 years of operation. Based on this information, onsite and offsite land use impacts from constructing and operating a new nuclear power plant could range from SMALL to MODERATE depending on how much additional land may be needed for uranium mining and fuel fabrication.

4.2.4.2 Visual Resources

Construction and Operations

Visual impacts from a new nuclear alternative would be similar to the common impacts of all replacement power alternatives described in Section 4.2.3.2, “Visual Resources.” The visual appearance of the power block for the new nuclear power plant would be virtually identical to the existing Turkey Point Units 3 and 4 power blocks. Mechanical draft cooling towers and associated condensate plumes would add to the visual impact. However, the height of the mechanical draft cooling towers would not likely exceed those of other buildings at the Turkey Point site. Therefore, visual impacts during the construction and operation of a new nuclear power plant at the Turkey Point site, including steam plumes that could be visible from great distances, could range from SMALL to MODERATE depending on seasonal weather conditions.

4.2.5 Natural Gas Combined-Cycle Alternative

4.2.5.1 Land Use

Construction

The natural gas combined-cycle (NGCC or natural gas) power plant would require 75 ac (30 ha) of land with up to an additional 1,200 ac (490 ha) needed for right-of-way to connect with existing natural gas supply lines located approximately 100 miles (mi) (161 kilometers (km)) north of the Turkey Point site. No new gas wells would be needed to support a natural gas power plant (FPL 2018f). This land use impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Turkey Point Units 3 and 4. Land use impacts caused by uranium mining and natural gas extraction and collection are described in Section 4.15.1, “Fuel Cycle.”

Constructing the natural gas power plant at the Turkey Point site would make use of available infrastructure. In addition, the land is already zoned for industrial use. However, some natural areas could be converted to industrial use if portions of the new power plant are built outside the existing industrial footprint. Although this use of the land would be noticeable, construction would not likely destabilize adjacent land use, due to the current industrial nature of the Turkey Point site. Accordingly, construction impacts could have SMALL to MODERATE land use impacts. This is primarily due to the amount of non-industrially zoned land that could be affected by this alternative.

<u>Operations</u>

Operation of a natural gas power plant would not cause any additional land use changes; therefore, land use impacts during operations would be SMALL. Overall land use impacts of the natural gas combined-cycle alternative, including both construction and operation, would therefore range from SMALL to MODERATE.

4.2.5.2 Visual Resources

<u>Construction and Operations</u>

Visual impacts from a natural gas power plant would be similar to the description in Section 4.2.3.2, “Visual Resources,” for the common impacts from all replacement power alternatives. However, construction and operation of the natural gas power plant would have little to no additional visual impact. The height of the mechanical draft cooling towers would not likely exceed those of other buildings at the Turkey Point site. Therefore, visual impacts during the construction and operation of a new NGCC facility at the Turkey Point site, including steam plumes that could be visible from great distances, could range from SMALL to MODERATE depending on seasonal weather conditions.

4.2.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

4.2.6.1 Land Use

<u>Construction and Operations</u>

The natural gas power plant component of the combination alternative would require somewhat less land than the full-scale natural gas power plant described in Section 4.2.5.1. The natural gas power plant component would require 70 ac (28 ha) of land with up to an additional 1,200 ac (490 ha) needed for right-of-way to connect with existing natural gas supply lines located approximately 100 mi (161 km) north of the Turkey Point site. No new gas wells would be needed to support a natural gas power plant (FPL 2018f). Accordingly, land use impacts would be similar to or less than those described for the full-scale natural gas power plant alternative. However, the impacts could still range from SMALL to MODERATE.

A utility-scale solar photovoltaic (solar) facility would require approximately 470 ac (190 ha) of cleared land for the three proposed offsite solar power installations (FPL 2018f). Standalone solar facilities cannot be collocated with other land uses (such as grazing and crop-producing agricultural fields). Land use impacts would range from MODERATE to LARGE, depending on the amount and types of land uses that would be affected by construction of the four solar facilities.

Overall land use impacts of this combination natural gas and solar alternative would therefore range from SMALL to LARGE. This is primarily due to the amount and types of land uses that would be affected by the solar facilities.

4.2.6.2 Visual Resources

Construction and Operations

Visual impacts from the combination natural gas and solar alternative would be similar to the common impacts described in Section 4.2.3.2, "Visual Resources," for all replacement alternatives. However, construction and operation of the natural gas power plant would have little to no additional visual impact. The height of the mechanical draft cooling towers would likely not exceed those of other buildings at the Turkey Point site. Visual impacts of the natural gas component would be similar to the impacts described in Section 4.2.5.2.

The visual impacts of the solar components of this alternative would vary, depending on location and topography. Depending on the location, standalone solar facilities could have a MODERATE to LARGE visual impact. Visual resource impacts of the combination alternative could therefore range from SMALL to LARGE. This range is primarily due to the potential visual impacts from the solar photovoltaic components of this alternative.

4.2.7 Cooling Water System Alternative

4.2.7.1 Land Use

Construction and Operations

Construction of two mechanical draft cooling towers for a cooling water system alternative could require the relocation of existing support activities at the Turkey Point site. Because only previously disturbed industrial portions of the Turkey Point site would be used to accommodate the new cooling towers, land use impacts associated with the construction and operation of the mechanical draft cooling towers for the cooling water system alternative would be SMALL.

4.2.7.2 Visual Resources

Construction and Operations

Construction and operation of the two cooling towers for a cooling water system alternative would have little to no additional visual impact. The height of the mechanical draft cooling towers would be similar to the height of other buildings at the Turkey Point site. Temporary visual impacts may occur during construction from cranes and other construction equipment. During facility operations, cooling tower steam plumes could add to the existing visual impact. Therefore, visual impacts during the construction and operation of two new cooling towers at the Turkey Point site, including steam plumes that could be visible from great distances, could range from SMALL to MODERATE depending on seasonal weather conditions.

4.3 Air Quality and Noise

This section describes the potential air quality and noise impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.3.1 Proposed Action

4.3.1.1 Air Quality

According to the GEIS (NRC 1996 and NRC 2013a), the generic issues related to air quality as identified in Table 4-1 above would not be affected by continued operations associated with license renewal. As discussed in Chapter 3, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of those generic issues related to air quality would be SMALL. Table 4-2 does not identify any site-specific (Category 2) air quality issues for Turkey Point Units 3 and 4.

4.3.1.2 Noise

According to the GEIS (NRC 1996 and NRC 2013a), noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the subsequent license renewal term. In addition, nuclear plant operations at Turkey Point Units 3 and 4 have not changed appreciably with time, and no change in noise levels or noise-related impacts are expected during the subsequent license renewal term.

The NRC staff identified no new or significant information during its review of the FPL environmental report, at the site visit, through the scoping process, or in the evaluation of other available information. Consequently, people living in the vicinity of Turkey Point Units 3 and 4 would not experience any changes in noise levels during the subsequent license renewal term beyond what is currently being experienced. Therefore, the impact of continued reactor operations during the subsequent license renewal term would not exceed the noise impacts predicted in the GEIS. For these issues, the GEIS predicts that noise impacts would be SMALL for all nuclear plants.

As identified in Table 4-1, the impacts of all generic noise issues would be SMALL. Table 4-2 does not identify any site-specific (Category 2) noise issues for Turkey Point Units 3 and 4.

4.3.2 No-Action Alternative

4.3.2.1 Air Quality

Under the no-action alternative, there would be a reduction in air pollutant emissions from activities related to the cessation of Turkey Point operations, such as the use of combustion sources (diesel generators, engines) and vehicle traffic. Activity from these air emission sources would not cease, but emissions would be lower. Therefore, the NRC staff concludes that if emissions decrease, the impact on air quality from the shutdown of Turkey Point would be SMALL

4.3.2.2 Noise

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and reactor operations at Turkey Point Units 3 and 4 would shut down on or before the expiration of the current renewed operating licenses. The termination of reactor operations would result in a reduction in noise sources throughout the nuclear facility, including noise from turbine generators, machinery, pumps, and other noise-generating equipment, and some vehicular traffic. Therefore, noise impacts resulting from the no-action alternative would be SMALL.

4.3.3 Replacement Power Alternatives: Common Impacts

4.3.3.1 Air Quality

<u>Construction</u>

Construction of a power station under a replacement power alternative would result in temporary impacts on local air quality. Air emissions would be intermittent and would vary based on the level and duration of specific activities throughout the construction phase. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling to and from the facility as well as within the site. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicle traffic on unpaved surfaces, concrete batch plant operations, and wind erosion to a lesser extent. Various mitigation techniques and best management practices (e.g., watering disturbed areas, reducing equipment idle times, and using ultra-low sulfur diesel fuel) could be used to minimize air emissions and to reduce fugitive dust. Implementation of a dust-control plan would also address reasonable precautions that would be needed to prevent fugitive particulate emissions in accordance with Florida Administrative Code 62-296.320(4)(c)3. Air emissions include criteria pollutants (particulate matter, nitrogen oxides, carbon monoxide, and sulfur dioxide), volatile organic compounds, hazardous air pollutants, and greenhouse gases (GHGs). Small quantities of volatile organic compounds and hazardous air pollutants would also be released from equipment refueling, onsite maintenance of the heavy construction equipment, and other construction finishing activities as well as from cleaning products, petroleum-based fuels, and certain paints.

<u>Operations</u>

The impacts on air quality as a result of operation of a power station for a replacement power alternative will depend on the energy technology (i.e., fossil-fuel based or nuclear). Fossil fuel-based power plants result in larger amounts of air emissions than nuclear power plants. Worker vehicles, auxiliary power equipment, and mechanical draft cooling tower operation will result in additional air emissions.

4.3.3.2 Noise

<u>Construction</u>

Construction of a replacement power facility would be similar to the construction of any industrial facility in that all involve many noise-generating activities. In general, noise emissions would vary during each phase of construction, depending on the level of human activity, types of equipment and machinery used, and site-specific conditions. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities could take place. Other noise sources include construction worker vehicle and truck delivery traffic. However, noise from vehicular traffic would be intermittent and would generate noise at levels similar to noise levels from Turkey Point Units 3 and 4 reactor operations.

Operations

Noise generated during operations could include noise from mechanical draft cooling towers, transformers, turbines, machinery, equipment, and communication announcements and sirens, as well as offsite sources, such as employee and delivery vehicular traffic. Noise from vehicles would be intermittent and at levels similar to noise levels generated by vehicles at Turkey Point. Similarly, with the exception of noise from mechanical draft cooling towers, operational noise levels at a replacement power plant would likely be similar to existing noise levels at Turkey Point Units 3 and 4.

4.3.4 New Nuclear Alternative

4.3.4.1 Air Quality

Construction

Air emissions and sources associated with construction of the new nuclear alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." Because air emissions from construction activities would be limited, local, and temporary, the NRC staff concludes that the associated air quality impacts from construction of a new nuclear alternative would be SMALL.

Operations

Operation of a new nuclear generating plant would result in air emissions similar in magnitude to air emissions from the operation of Turkey Point. Sources of air emissions would include stationary combustion sources (e.g., diesel generators, auxiliary boilers, and fire pumps) and mobile sources (e.g., worker vehicles, onsite heavy equipment, and support vehicles). Additional air emissions would result from the new nuclear plant's use of mechanical draft cooling towers rather than the cooling canal system currently used by Turkey Point and could contribute to impacts associated with the formation of visible plumes, fogging, and subsequent icing downwind of the towers. In general, most stationary combustion sources at a nuclear power plant would operate only for limited periods, often during periodic maintenance testing. A new nuclear power plant would need to secure a permit from the Florida Department of Environmental Protection for air pollutants associated with its operations (e.g., criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases). The NRC staff expects the air emissions for combustion sources from a new nuclear plant to be similar to those currently being emitted from Turkey Point Units 3 and 4 (see Section 3.2.1). Emissions from the mechanical draft cooling towers would be approximately 15 tons/year for particulate matter less than 10 microns and 0.08 tons/year for particulate matter less than 2.5 microns (NRC 2016a). Therefore, the NRC staff expects that the combined air quality impact of emissions from onsite sources would be minor. Additional air emissions would result from the approximately 800 employees commuting to and from the new nuclear facility. The NRC staff does not expect air emissions from operation of a new nuclear alternative to contribute to National Ambient Air Quality Standard violations. The NRC staff concludes that the impacts of operation of a new nuclear alternative on air quality would be SMALL.

4.3.4.2 Noise

Construction

Noise generated during the construction and operation of a new nuclear power plant would be similar to noise for all replacement power alternatives as discussed in Section 4.3.3.2, "Noise." In addition, Sections 4.8.2 and 5.8.2 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) describe noise impacts generated during construction and operation of proposed Turkey Point Units 6 and 7; those noise impacts would be similar to the noise impacts of constructing and operating new nuclear plants to replace Units 3 and 4. Accordingly, the NRC staff incorporates the information in Sections 4.8.2 and 5.8.2 of NUREG-2176 here by reference (NRC 2016a). Noise impacts during construction would be limited to the immediate vicinity of the Turkey Point site. Because of the distance of the site to potential receptors, noise impacts during the construction of a new nuclear power facility at the Turkey Point site could range from SMALL to MODERATE depending on the noise-sensitive receptor.

Operations

Mechanical draft cooling towers generate noise during operations. Other sources of noise during nuclear power plant operations would include industrial equipment, machinery, vehicles, and communications. In general, noise would be limited to the immediate vicinity of the Turkey Point site and, with the exception of the cooling towers, noise levels would be similar to noise levels generated during the operation of Turkey Point Units 3 and 4. Therefore, noise impacts during power plant operations for a new nuclear plant would be SMALL.

4.3.5 Natural Gas Combined-Cycle Alternative

4.3.5.1 Air Quality

Construction

Air emissions and sources associated with construction of the natural gas alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." There would also be additional air emissions resulting from construction of a new or upgraded pipeline that would connect to existing natural gas supply lines north of the site. Air emissions would be localized, intermittent, and short lived, and adherence to well-developed and well-understood construction best management practices would mitigate air quality impacts. Therefore, the NRC staff concludes that construction-related impacts on air quality from a natural gas alternative would be of relatively short duration and would be SMALL.

Operations

Operation of a natural gas plant would result in emissions of criteria pollutants and greenhouse gases. The sources of air emissions during operation include gas turbines through heat recovery steam generator stacks. The staff estimated air emissions for the natural gas alternative using emission factors developed by the U.S. Department of Energy's National Energy Technology Laboratory (NETL 2010a). Assuming a total gross capacity of 1,726 MW and a capacity factor of 0.87 (FPL 2018f), the NRC staff estimates the following air emissions would result from operation of a natural gas alternative:

- sulfur oxides—20 tons (18 metric tons (MT)) per year
- nitrogen oxides—440 tons (400 MT) per year
- carbon monoxide—45 tons (41 MT) per year
- PM_{10}—32 tons (29 MT) per year
- carbon dioxide equivalents (CO_{2eq})—5.7 million tons (5.2 million MT) per year

Operation of the mechanical draft cooling towers and up to 150 worker vehicles would also result in additional criteria emissions above those presented in the list. A new natural gas plant would qualify as a major emitting industrial facility. As such, the new natural gas plant would be subject to Prevention of Significant Deterioration (PSD) and Title V air permitting requirements under the Clean Air Act of 1970, as amended (42 U.S.C. 7651 et seq.), to ensure that air emissions are minimized and that the local air quality is not substantially degraded. Additionally, various Federal and State regulations aimed at controlling air pollution would affect a natural gas alternative.

Based on the NRC staff's air emission estimates, nitrogen oxide and greenhouse gas emissions from a natural gas plant would be noticeable and significant. Carbon dioxide emissions would be much larger than the threshold in the U.S. Environmental Protection Agency's (EPA's) Greenhouse Gas Tailoring Rule, and nitrogen oxide emissions would exceed the threshold for major sources. The NRC staff concludes that the overall air quality impacts associated with operation of a natural gas alternative would be SMALL to MODERATE.

4.3.5.2 Noise

<u>Construction</u>

In addition to the common impacts discussed in Section 4.3.3.2, "Noise," for all replacement power alternatives, additional noise would be generated during the construction of pipelines to support a natural gas power plant. Because of the distance involved in pipeline construction, noise impacts during the construction of a natural gas power plant and gas pipeline could range from SMALL to MODERATE depending on the location of noise-sensitive receptors along the gas pipeline.

<u>Operations</u>

Noise generated during the operation of a natural gas power plant would include noise from mechanical draft cooling towers, compressor stations, and pipeline blowdowns. However, the majority of noise-producing equipment (e.g., mechanical draft cooling towers, turbines, pumps) would be located inside the power block. Therefore, noise impacts during power plant operations would be SMALL.

4.3.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

4.3.6.1 Air Quality

Construction

Air emissions and sources associated with construction of both the natural gas and solar portions of this combination alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." Air emissions from construction would be localized and intermittent, and well-understood construction best management practices would mitigate air quality impacts. Therefore, the NRC staff concludes that construction-related impacts on air quality from the combination alternative would be SMALL.

Operations

Air emissions associated with the operation of the natural gas portion of the combination alternative would be similar to those associated with the natural gas alternative. However, emissions associated with the natural gas portion of the combination alternative are slightly reduced because the electricity output of the natural gas unit under the combination alternative would be approximately 95 percent of that of the natural gas-only alternative.

The NRC staff estimates the following air emissions for the natural gas portion of the combination alternative based on emission factors developed by the U.S. Department of Energy's National Energy Technology Laboratory (NETL 2010a):

- sulfur oxides—19 tons (18 metric tons (MT)) per year
- nitrogen oxides—420 tons (380 MT) per year
- carbon monoxide—43 tons (39 MT) per year
- PM_{10}—30 tons (28 MT) per year
- carbon dioxide equivalents (CO_{2eq})—5.4 million tons (4.9 million MT) per year

Operation of the mechanical draft cooling towers and up to 150 worker vehicles would also result in additional criteria emissions above those presented in the list. The new natural gas units would qualify as major emitting industrial facilities and would be subject to Prevention of Significant Deterioration and Title V air permitting programs aimed at controlling air pollution. Carbon dioxide emissions would be greater than the threshold in EPA's Greenhouse Gas Tailoring Rule, and nitrogen oxide and carbon monoxide emissions would exceed the threshold for major sources.

Air emissions associated with the operation of solar energy facilities are negligible because no fossil fuels are burned to generate electricity. Emissions from solar fields would include fugitive dust and engine exhaust emissions from vehicles and heavy equipment associated with site inspections, maintenance activities (panel washing or replacement), and wind erosion from cleared lands and access roads. The types of emission sources and pollutants during operation would be similar to those during construction, but much fewer emissions would be released during operation. These emissions should not cause exceedances of air quality standards or have any impacts on climate change. The NRC staff concludes that the overall air quality impacts associated with operation of the combination alternative would be SMALL to MODERATE.

4.3.6.2 Noise

<u>Construction</u>

Construction-related noise sources for the natural gas power plant portion of the combination alternative would be similar to the impacts discussed for the natural gas-only power plant alternative in Section 4.3.5.2, "Noise," and the common impacts discussed in Section 4.3.3.2, "Noise," for all replacement power alternatives. Noise impacts during the construction of a solar facility could range from SMALL to MODERATE depending on its location in proximity to noise-sensitive receptors. Therefore, construction impacts from the combination alternative could range from SMALL to MODERATE depending on the location of noise-sensitive receptors.

<u>Operations</u>

Noise generated during natural gas power plant operations would include noise from mechanical draft cooling towers, compressor stations, and pipeline blowdowns. Noise impacts during operation of the natural gas power plant component of the combination alternative would be similar to those described in Section 4.3.5.2. Except for maintenance activities, very little noise would be generated by the solar facility. Therefore, noise impacts during facility operations from the combination alternative would be SMALL.

4.3.7 Cooling Water System Alternative

4.3.7.1 Air Quality

<u>Construction and Operations</u>

Under the cooling water system alternative, three plume-abated wet mechanical draft cooling towers would be constructed for each reactor unit. Air emissions from construction of the cooling towers would result from the exhaust of construction equipment, worker vehicle exhaust, land disturbance activities (land-clearing, excavation), and demolition activities. Fuel combustion exhaust would emit criteria pollutants and greenhouse gases while land-disturbance and demolition activities would result in fugitive dust.

Potential atmospheric impacts from cooling system operation include the formation of visible plume, fogging, and subsequent icing downwind of the towers. Operation of cooling towers would also result in the emission of particulate matter from cooling tower drift, with higher concentrations of dissolved solids associated with the potential use of seawater as a secondary source of cooling water. However, modern cooling towers equipped with drift eliminators would minimize the loss of water from the cooling towers via drift. As stated in Section 5.7.2 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176), cooling tower emissions would be required to adhere to the New Source Performance Standards (40 CFR 60.40, "Applicability and Designation of Affected Facility") and demonstrate compliance with ambient air-quality standards by acquiring a Prevention of Significant Deterioration permit under the Clean Air Act before the cooling towers could be operated (NRC 2016a).

Replacement power may be needed during both construction and operation of a mechanical draft cooling tower system at Turkey Point. Following cooling tower construction, Turkey Point Units 3 and 4 would be offline for at least a short time during the switchover from use of the cooling canal system (CCS) to cooling towers. Some replacement power could also be required once Turkey Point's cooling tower system is online to compensate for the additional power needed to operate cooling tower pumps and fans. Replacement power would come from common types of existing technology within the region (natural gas, nuclear, and coal), and it is not likely that new facilities would be constructed. The impacts on air quality would depend on the specific location and technology of the replacement power facilities.

In Sections 4.7 and 5.7 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176), the NRC staff determined that air impacts from the construction and operation of Units 6 and 7, including those associated with the construction and operation of the mechanical draft cooling towers, would be SMALL (NRC 2016a). As described in Section 2.2.3, "Cooling Water System Alternative," of this SEIS, construction and operation of mechanical draft cooling towers for Units 3 and 4 would be similar to, but proportionally smaller than, the impacts described in the NUREG-2176 analysis for Units 6 and 7. Therefore, the NRC staff concludes that the air quality impacts from the construction and operation of mechanical draft cooling towers to support Turkey Point Units 3 and 4 would be SMALL.

4.3.7.2 Noise

<u>Construction</u>

Construction-related noise during construction of the cooling towers for the cooling water system alternative would be similar to the impacts discussed in Section 4.3.3.2, "Noise," as common to all replacement power alternatives. Because of the distance from the site to noise-sensitive receptors, noise impacts during construction of the cooling towers for the cooling water system alternative at the Turkey Point site could range from SMALL to MODERATE depending on the noise-sensitive receptor.

<u>Operations</u>

As previously discussed, mechanical draft cooling towers generate noise during operations. In general, noise impacts when the cooling towers for the cooling water system alternative are operating would be limited to the immediate vicinity of the Turkey Point site and would be SMALL.

4.4 <u>Geologic Environment</u>

This section describes the potential geology and soil resource impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.4.1 Proposed Action

According to the 2013 GEIS (NRC 2013a), plant-specific environmental reviews conducted by the NRC had not identified any significant impact issues related to geology and soil resources. The NRC staff's review of the Turkey Point subsequent license renewal application has not identified any new or significant information that would change the conclusion in the GEIS. Thus, as concluded in the GEIS, the impacts of continued operation on geology and soil resources would be SMALL.

As identified in Table 4-1, the impacts of the single geologic environment issue (geology and soils) would be SMALL. Table 4-2 does not identify any site-specific (Category 2) geologic environment issues.

4.4.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses and Turkey Point Units 3 and 4 would shut down on or before the expiration of the current renewed licenses. There would not be any impacts to the geology and soils at the Turkey Point site with the shutdown of the facility. With the shutdown of the facility, no additional land would be disturbed. Therefore, the NRC staff concludes that impacts on geology and soil resources from the no-action alternative would be SMALL.

4.4.3 Replacement Power Alternatives: Common Impacts

Under all replacement power alternatives, construction impacts would be temporary and localized. During construction for all the replacement power alternatives, sources of aggregate material (such as crushed stone, sand, and gravel) would be required to construct buildings, foundations, roads, and parking lots. The NRC staff presumes that these resources would likely be obtained from commercial suppliers using local or regional sources.

During construction of all replacement power alternatives, no previously undisturbed soils would be impacted. Organic soil or “muck” on the proposed building site would be removed and disposed of in several locations on the berms alongside the main return canal and southern canal of the CCS (also called the industrial wastewater facility). Prior to placement of spoils material, part of the surface would be excavated, and small containment berms would be created to form a shallow excavation in which to place the spoils. Material that is removed from the excavations and is not suitable for reuse would be placed in these areas for dewatering and disposal. FPL has indicated that measures such as berms, riprap, sedimentation filters, and detention ponds would be used to control drainage from the spoils piles to the CCS (NRC 2016a).

During operation of replacement power alternatives, no additional land would be disturbed. Therefore, NRC staff concludes that the common impacts of operations of replacement power alternatives on geology and soil resources would be SMALL.

4.4.4 New Nuclear Alternative

The NRC staff did not identify any impacts to the geologic environment for the new nuclear alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to geology and soil resources from the new nuclear alternative would be SMALL.

4.4.5 Natural Gas Combined-Cycle Alternative

The NRC staff did not identify any impacts to the geologic environment for the natural gas alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to geology and soil resources from the natural gas alternative would be SMALL.

4.4.6 Combination Natural Gas Combined-Cycle and Solar Photovoltaic Alternative

For the natural gas component of this alternative, the NRC staff did not identify any impacts to the geologic environment beyond those discussed above as common to all replacement power alternatives. However, the solar component of this alternative would require land to be cleared for solar power installations. The corresponding impacts on soil resources would be noticeable, but they would not destabilize important attributes of the resource. Therefore, the NRC staff concludes that the impacts to geology and soil resources from the combination natural gas and solar alternative would be MODERATE.

4.4.7 Cooling Water System Alternative

The NRC staff did not identify any impacts to the geologic environment for the cooling water system alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to geology and soil resources from the cooling water system alternative would be SMALL.

4.5 Water Resources

This section describes the potential surface water and groundwater resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.5.1 Proposed Action

4.5.1.1 Surface Water Resources

According to the GEIS (NRC 1996 and NRC 2013a), for the most part, no significant surface water impacts for Category 1 (generic) issues are anticipated during the license renewal term that would be different from those occurring during the current license term. The NRC staff's review of the Turkey Point SLR application has not identified any new and significant information that would change the conclusion in the GEIS. Thus, as concluded in the GEIS, for these Category 1 (generic) issues, the impacts of continued operation on surface water resources would be SMALL.

Table 4-1 in Section 4.1 lists "Applicable Category 1 (Generic) Issues for Turkey Point." The impacts for these issues are SMALL. While no Category 2 (site-specific) issues applicable to the Turkey Point site have been identified, the NRC staff did evaluate the significance of new information for the impacts from the CCS on adjacent surface water bodies via the groundwater pathway. As discussed below, this information was determined not to be significant for Turkey Point subsequent license renewal.

<u>New Issue, Water Quality Impacts on Adjacent Water Bodies (Plants with Cooling Ponds in Salt Marshes)</u>

As part of its review of the Turkey Point subsequent license renewal application, the NRC staff identified new information regarding nuclear power plant operations that can act upon the environment in a manner or in an intensity or scope (context) not previously recognized. Specifically, the GEIS (NUREG–1437) did not consider how a nuclear power plant with a cooling pond in a salt marsh may indirectly impact the water quality of adjacent surface water bodies via a groundwater pathway. This constitutes a new, site-specific issue with respect to Turkey Point, for which the NRC staff has prepared the following site-specific analysis.

In its environmental report, FPL identified the Category 1 issue, "Altered salinity gradients," as applicable to Turkey Point Units 3 and 4 operations. However, the NRC staff has determined that this issue is not applicable to Turkey Point due to the unique configuration of the Turkey Point CCS. As indicated in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 and as further described in the GEIS (NRC 2013a), the issue, “Altered salinity gradients,” only applies to nuclear power plants located on estuaries and changes in salinity due to the operational effects of intake and discharge structures in estuaries. At Turkey Point, the intake and discharge structures associated with Units 3 and 4 are located within the enclosed CCS, which does not directly discharge to the surface waters of Biscayne Bay. Nonetheless, the NRC staff has evaluated new and potentially significant information related to the operation of the CCS and its effects on salinity within the Biscayne aquifer under the issue, “Groundwater quality degradation (plants with cooling ponds in salt marshes),” in Section 4.5.1.2 of this SEIS rather than under the new issue discussed in this section.

For this new issue (water quality impacts on adjacent water bodies), Sections 3.1.3, “Cooling and Auxiliary Water Systems,” and 3.5.1, “Surface Water Resources,” of this SEIS present relevant new information related to the water quality of surface waters adjacent to Turkey Point and the Turkey Point site. Much of this information did not become available until many years after the NRC had issued the initial renewed licenses for Units 3 and 4 in 2002 and was not available at the time that the 2013 GEIS was prepared. The following discussion is based on information summarized in the aforementioned sections of this SEIS.

Turkey Point Units 3 and 4 do not consume surface water or discharge directly to natural surface water bodies. All surface water discharges from Turkey Point flow into the CCS. As described in Section 3.1.3.2 of this SEIS, the CCS is surrounded by perimeter berms that are designed to keep water from entering the CCS. The perimeter berms are built on top of the bedrock, while water levels in the CCS are below the top of the bedrock. The perimeter berms are not in contact with water within the CCS. However, the water in the CCS is in contact with and hydrologically connected to the Biscayne aquifer. The Biscayne aquifer, in turn, is hydrologically connected to the surrounding marsh land, mangrove areas, adjacent drainage canals, Biscayne Bay, and Card Sound.

Water in the CCS is considered industrial wastewater and is not recognized as a usable resource. Therefore, only the impacts from CCS operation on the water quality of adjacent surface water bodies via the groundwater pathway from the CCS through the Biscayne aquifer are considered in this analysis.

The Florida legislature has designated Biscayne Bay and Card Sound, including Biscayne National Park, as “Outstanding Florida Waters.” This designation affords these waters the highest water quality protections in the State.

The impact of temperature, salinity, ammonia, and nutrients on water quality has been the focus of CCS operational concerns. It has been reported that increased levels of ammonia, other nutrients, or salinity had been found in local areas adjacent to the CCS, however, as discussed below and in Chapter 3 of this SEIS, discernable effects from CCS derived temperature, ammonia, nutrients, and salinity on Biscayne Bay or Card Sound water qualities has not been detected.

As discussed in Section 3.5.1.4 of this SEIS, ammonia concentrations in the water within the CCS are below the Miami-Dade County ammonia water quality standard. Also as discussed in Section 3.5.1.4, adjacent surface water bodies contain ammonia from natural sources that occur within the water body (e.g., through decay of organic matter). Noticeable concentrations of ammonia have been found in two deep excavations outside of and adjacent to the CCS that contain stagnant water (i.e., the Barge Turning Basin and the remnant canal at Turtle Point). To prevent the movement of ammonia from the CCS into these areas, FPL is undertaking mitigation activities, as discussed below.

Thermal impacts on adjacent water bodies from the CCS have not been detected. Similarly, impacts on surrounding marsh and mangrove areas from CCS contributions of ammonia, nutrients, and salinity have not been detected. Impacts on adjacent canals from CCS contributions of ammonia, nutrients, and salinity have been slight. Water that likely originated from the CCS has sporadically been detected in two canals adjacent to the CCS. However, the water quality in these two canals has not been degraded sufficiently to prevent these canals from achieving their intended purpose (i.e., transporting fresh water, draining the land, and flood control). Further, little if any influence on surface water quality in Card Sound was detected from the discharge of these two canals into Card Sound.

As described in Section 3.5.2, "Groundwater Resources," hypersaline water originating in the CCS is moving eastward beneath Biscayne Bay at depth along the base of the Biscayne aquifer. The program implemented by FPL to extract hypersaline groundwater from the Biscayne aquifer (on the west side of the CCS) is not designed to remove the hypersaline groundwater beneath Biscayne Bay (on the east side of the CCS). Because the hypersaline groundwater is denser than seawater, the hypersaline groundwater is found at the bottom of the Biscayne aquifer and is moving down the eastward dip of the aquifer. Upward movement of this hypersaline water from the Biscayne aquifer and into Biscayne Bay and Card Sound has not been detected in either pore water or shallow monitor well samples collected in the Bay and Sound.

In accordance with agreements reached with and/or requirements imposed by the Florida DEP and Miami-Dade County DERM, FPL is implementing programs to control ammonia and nutrients and to reduce salinities within the CCS. These programs (which include adding fresh or lower salinity water to the CCS, pumping hypersaline water from groundwater, and monitoring and reporting requirements) are expected to reduce the impact of the CCS on groundwater quality within the Biscayne aquifer. In turn, the potential impacts on surface water quality via groundwater from the CCS via the groundwater pathway would also be reduced. These programs are expected to reduce the amount of hypersaline groundwater originating from the CCS. Hypersaline groundwater flow from the CCS beneath Biscayne Bay would, however, continue to move eastward and downgradient along the base of the Biscayne aquifer.

While this is a new site-specific issue that has been identified for Turkey Point, upon consideration of the FDEP's and DERM's existing requirements and their continuing oversight of FPL's site remediation efforts, the NRC staff concludes that the impacts on adjacent surface water bodies via the groundwater pathway from the CCS during the subsequent license renewal term would be SMALL and, therefore, the new information that has been identified is not significant.

4.5.1.2 Groundwater Resources

According to the GEIS (NRC 1996 and NRC 2013a), groundwater resources would not be significantly affected by continued operations associated with license renewal in most circumstances. As discussed in Section 3.5.2 of this SEIS, the NRC staff identified no new and significant information for most issues relating to groundwater use and quality. As identified in Table 4-1, the impacts for most applicable generic groundwater resources issues would be SMALL. However, during its review of FPL's environmental report, site visit, scoping process, and evaluation of other available information, the NRC staff identified new information regarding the generic groundwater resource issue of "Groundwater quality degradation (plants with cooling ponds in salt marshes)." The NRC staff's evaluation of the significance of this new information follows.

<u>New Information, Category 1 Issue, Groundwater Quality Degradation (Plants with Cooling Ponds in Salt Marshes)</u>

As referenced in Section 1.4 of this SEIS and as further described in Sections 1.5 and 1.8 of the GEIS (NUREG-1437) (NRC 2013a), no additional site-specific analysis is required by the NRC staff for Category 1 (generic) issues in the SEIS unless new and significant information is identified that would change the conclusions in the GEIS. Where new and significant information has been identified, the NRC staff will reconsider generic impacts in the SEIS.

The Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," was first evaluated in the 1996 GEIS (NRC 1996) and was reconsidered as part of the update to the GEIS, issued in June 2013 (NRC 2013a).

For the subject issue, the 2013 GEIS (NRC 2013a: 4-50, 4-51) provides the following technical basis with respect to nuclear power plants that use cooling ponds as part of their cooling water system discharge:

> Nuclear plants that use cooling ponds as part of their cooling water system discharge effluent to the pond. The effluent's concentration of contaminants and other solids increases relative to that of the makeup water as it passes through the cooling system. These changes include increased total dissolved solids (or TDS), since they concentrate as a result of evaporation, increased heavy metals (because cooling water contacts the cooling system components), and increased chemical additives to prevent biofouling. Because all the ponds are unlined (NRC 1996), the water discharged to them can interact with the shallow groundwater system and may create a groundwater mound. In this case, groundwater below the pond can flow radially outward, and this groundwater would have some of the characteristics of the cooling system effluent.
>
> In salt marsh locations, the groundwater is naturally brackish (i.e., with a TDS concentration of about 1,000 to more than 10,000 milligrams per liter [mg/L]) and, thus, is already limited in its uses. As such, this issue concerns only the potential for changing the groundwater use category of the underlying shallow and brackish groundwater due to the introduction of cooling water contaminants. Two nuclear plants, South Texas in Texas and Turkey Point in Florida, have cooling systems (man-made cooling pond and cooling canal system, respectively) located relatively near or constructed in salt marshes. Plants relying on brackish water cooling systems would not further degrade the quality of the shallow aquifer relative to its use classification. This is because groundwater quality beneath salt marshes is already too poor for human use (i.e., it is non-potable water) and is only suitable for industrial use.

The NRC staff concluded in the GEIS (NUREG-1437) (NRC 2013a: 4-50, 4-51) that operational impacts from cooling ponds located in salt marshes would have a SMALL impact on groundwater quality, and no new information was identified that would alter this conclusion.

Section 3.5.2.2 of this SEIS presents and considers in detail relevant new information related to groundwater quality at the Turkey Point site that supports the staff's reconsideration of the generic impacts of the subject issue. This information is summarized below. The CCS used by Turkey Point Units 3 and 4 and other generating facilities at the Turkey Point site is an expansive water body formed by excavation into the marshes and underlying bedrock. Because the CCS is unlined, it is hydraulically connected to the upper Biscayne aquifer, permitting the movement of water between the CCS and the aquifer through the bedrock. Water in the CCS is hypersaline (i.e., the water has a salinity greater than that of natural seawater, with a chloride concentration exceeding 19,000 mg/L). Over the operational life of the CCS, the annual average salinity of the waters within the CCS and the hypersaline groundwater plume beneath it has increased. The existence of a hypersaline plume beneath the CCS was known at the time the NRC staff prepared its SEIS for the initial license renewal for Turkey Point in 2002. At the time, however, and at the time of the 2013 update to the GEIS (NRC 2013a), the potential for the hypersaline plume to migrate down through the Biscayne aquifer and then move laterally beyond the boundaries of the CCS was not known.

Beginning in 2010, FPL initiated an expanded groundwater monitoring program in accordance with State regulatory approvals of the Turkey Point extended power uprate (EPU) project, to determine the horizontal and vertical effects of CCS water on the environment. Monitoring results demonstrated that CCS operations have impacted groundwater quality in the Biscayne aquifer beyond the boundaries of the CCS and FPL property, both to the west of the site as well as beneath Biscayne Bay to the east of the Turkey Point site. The hypersaline plume emanating from the CCS has migrated along the base of the Biscayne aquifer to the west into groundwater designated by the State as Class G-II, potable water use (defined as having total dissolved solids (TDS) levels of less than 10,000 mg/L). Currently, FPL reports that hypersaline water from the CCS extends out approximately 1.5 mi (2.4 km) west of the CCS boundary.

The NRC staff concludes that the contribution of past CCS hypersaline water on offsite groundwater quality is difficult to quantify, in that statements by the State of Florida (FDEP 2014a) and analyses prepared by FPL, as referenced in Section 3.5.2.2 of this SEIS, indicate that saltwater was present as early as the 1940s near the base of the Biscayne aquifer west of the Turkey Point site (i.e., prior to completion of CCS construction in 1973). In addition, groundwater data from the early 1970s supported the determination that non-potable groundwater occurred beneath much of the area now occupied by the CCS and within the deeper portions of the aquifer west of the site. Thus, portions of the Biscayne aquifer to the west of the CCS did not meet Class G-II groundwater criteria prior to CCS construction. This earlier groundwater quality degradation is attributable to regional saltwater intrusion, which had already occurred across southeast Miami-Dade County and the Turkey Point site due to historic land use alterations and groundwater withdrawals that induced saltwater migration from east to west along the base of the Biscayne aquifer (FDEP 2014a, NRC 2016a).

However, the fact that CCS operations have measurably degraded groundwater quality beyond the general confines of the CCS structure and Turkey Point site boundaries is generally not in dispute. Furthermore, it is apparent that water from the CCS has migrated to the west and toward areas where groundwater within the Biscayne aquifer is of sufficient quality to support its use as a potable water supply. Vertical trends in monitoring wells for such parameters as chloride, TDS, and tritium concentrations indicate the influence of CCS water in groundwater both to the west and east of the Turkey Point site, as discussed in Section 3.5.2.2 of this SEIS. Consequently, in accordance with regulatory mechanisms imposed by Miami-Dade County (MDC 2015a) and FDEP (FDEP 2016e), FPL initiated operation of a groundwater remediation system in May 2018, to intercept, capture, and retract the hypersaline plume within a 10-year timeframe.

Groundwater monitoring results for tritium also indicate that the extent of potential influence of CCS water (based on a tritium concentration of 20 pCi/L or greater as measured near the base of the Biscayne aquifer) extends as far as 4.5 mi (7.2 km) west of the CCS at monitoring well TPGW-7 and approximately 2 mi (3.2 km) east beneath Biscayne Bay (see Figure 3-13 of this SEIS). These monitoring results show that the extent of tritium migration exceeds the extent of the hypersaline plume from the CCS (as noted above, FPL reports that hypersaline water from the CCS extends out approximately 1.5 mi (2.4 km) west of the CCS boundary). Nonetheless, using 20 pCi/L for tritium as a standard, near monitoring well TPGW-7 to the west of the CCS, Class G-II groundwater criteria are met in the upper part of the Biscayne aquifer with the relatively fresh water band thickening to the west and away from the saltwater interface. This westward boundary (defined by the current estimate of the 20 pCi/L concentration boundary for tritium in groundwater) is approximately 2 mi (3.2 km) southeast of the Newton Wellfield that supplies potable water from the Biscayne aquifer to parts of Miami-Dade County. At no location outside the boundary of the Turkey Point site do tritium levels in groundwater approach the EPA and State primary drinking water standard for tritium (20,000 pCi/L), while the highest tritium levels observed in offsite monitoring wells near the site are approximately 15 percent of the standard.

Moreover, the northwestern-most boundary of the 20 pCi/L tritium concentration in the vicinity of monitoring well TPGW-7 closely aligns with the current location of the saltwater interface in the Biscayne aquifer in that area, as shown in Figure 3-12 of this SEIS. Both the U.S. Geological Survey (USGS) and FDEP have asserted that hypersaline water from the CCS contributes to the westward migration of the saltwater interface across southeast Miami-Dade County, as referenced in Section 3.5.2.2. Most recently, FPL reported to FDEP on the results of groundwater modeling (Tetra Tech 2018) that was performed using a variable density flow and salinity transport model to allocate relative contributions to the movement of the saltwater interface. The modeling results indicate that the operation of the CCS, in which the salinity exceeds 35 practical salinity units (PSU), is the single largest contributor to changes (movement) in the location of the saltwater interface, as measured by the areal extent of the saltwater interface (see Section 3.5.2.2).

Based on the information described above, the NRC staff finds that operation of the CCS under hypersaline conditions, and the migration of an associated hypersaline groundwater plume in the Biscayne aquifer, has contributed to the migration of the saltwater interface across portions of southeastern Miami-Dade County, to the west and north of the Turkey Point site.

Hypersaline groundwater containing tritium has migrated beyond the boundaries of the CCS and Turkey Point property at the base of the Biscayne aquifer from Class G-III groundwater (i.e., non-potable groundwater) into areas designated by the State of Florida as Class G-II groundwater (potable groundwater). As evidenced by elevated levels of tritium, the NRC staff finds that CCS-influenced water has migrated into portions of the Biscayne aquifer that are designated as a potential source of potable water. While the NRC staff also finds that the constituents of concern are not a human health concern at present, the water originating from the CCS has resulted in the degradation of groundwater quality to the west and east of the CCS, at least at the base of the Biscayne aquifer. In addition, as a source of hypersaline water, the discharge of CCS water to the base of the Biscayne aquifer has been and is currently contributing to the migration of the saltwater interface.

These aspects of cooling pond operations and their effects on groundwater quality were not considered in the GEIS as part of the technical basis for the Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)." The NRC staff has determined that this information is both new and significant. Based on the information identified, the NRC staff has concluded that the site-specific impacts for this issue at the Turkey Point site are MODERATE for current operations, but will be SMALL during the subsequent license renewal term as a result of ongoing remediation measures and State and county oversight, now in place at Turkey Point. The NRC staff has assigned these significance levels because the plume of hypersaline water from the CCS has measurably altered and degraded groundwater quality in the lower part of the Biscayne aquifer beyond the CCS and Turkey Point property, but hypersalinity is projected to decrease substantially as a result of ongoing remediation efforts.

As previously referenced and as detailed in Section 3.5.2.2, FPL entered into a consent agreement (MDC 2015a) with Miami-Dade County Division of Environmental Resources Management (DERM) in October 2015 and a consent order (FDEP 2016e) with FDEP in June 2016. Both compliance agreements require FPL to take measures to abate hypersaline water discharges from the CCS and to actively remediate the hypersaline groundwater west and north of FPL's property. In accordance with those requirements, FPL completed construction and commenced operation in May 2018 of a Biscayne aquifer recovery well system, to intercept, capture, and retract the hypersaline plume from the CCS to within FPL's property boundary. The South Florida Water Management District (SFWMD) issued FPL a water use individual permit (Permit No. 13-06251-W) in February 2017 for operation of this system (SFWMD 2017a).

In its environmental report, FPL states that operation of its recovery well system will achieve retraction of the plume back to the FPL site (i.e., Turkey Point site) boundary within 10 years, as required by the 2016 consent order with FDEP (FPL 2018f). As referenced in Permit No. 13-06251-W, the modeling commissioned by FPL to support the design and permitting of the recovery well system consists of a three-dimensional, density-dependent, groundwater flow and saltwater transport model (Tetra Tech 2016). Consistent with FPL's statements in its environmental report (FPL 2018f), the modeling results for the constructed well system predict retraction of the westward plume to the edge of the CCS by about 5 years and complete retraction within 10 years, with minor aquifer drawdown impacts. Both the 2015 consent agreement with the Miami-Dade County DERM (MDC 2015a) and the 2016 FDEP consent order (FDEP 2016e) require that FPL monitor the effectiveness of the system and periodically report the results to the agencies. If monitoring analysis shows that the system is not achieving remediation objectives, FPL must develop and submit alternative plans to the agencies. In the SFWMD report included as part of the permit, SFWMD states that system operation should, as part of the extraction of hypersaline groundwater, pull the saltwater interface in the Biscayne aquifer to the east from its current location and increase the amount of fresh groundwater in areas surrounding the CCS (SFWMD 2017a).

Groundwater models are approximations of natural systems and are dependent on a number of input variables based on assumptions regarding present and future environmental conditions. Thus, they entail substantial uncertainty. Nonetheless, the effectiveness of the recovery well system in halting and retracting the hypersaline plume is subject to regulatory oversight by FDEP and DERM, and the terms of the 2016 FDEP consent order and 2015 DERM consent agreement. Therefore, the NRC staff concludes that as a result of FPL's operation of its recovery well system and continued regulatory oversight and enforcement of the terms of the consent order and consent agreement by the FDEP and DERM, the impacts on groundwater quality from operations during the subsequent license renewal term would be SMALL. This conclusion is further supported by the fact that the subsequent license renewal term does not commence until 2032 and 2033, for Units 3 and 4, respectively, affording a substantial period of time for groundwater remediation and improvement to be accomplished prior to the subsequent period of extended operations.

Category 2 Issues

Table 4-2 identifies two Turkey Point site-specific (Category 2) issues related to groundwater resources during the subsequent license renewal term. These issues are analyzed below.

Groundwater Use Conflicts (Plants That Withdraw More Than 100 Gallons per Minute)

For nuclear power plants that withdraw more than 100 gpm (378 L/min) of groundwater to supply a plant's makeup cooling, service water, or potable water needs, there can be conflicts with other local groundwater users if the cone(s) of depression created by a facility's groundwater production extends to offsite well(s). This is a Category 2 issue.

In evaluating the potential impacts resulting from groundwater use conflicts associated with subsequent license renewal, the NRC staff uses as its baseline the existing groundwater resource conditions described in Sections 3.5.2.1 through 3.5.2.3 of this SEIS. These baseline conditions encompass the existing hydrogeologic framework and conditions (including aquifers) potentially affected by continued operations, as well as the nature and magnitude of groundwater withdrawals for cooling and other purposes (as compared to relevant appropriation and permitting standards). The baseline also considers other downgradient or in-aquifer uses and users of groundwater.

As described in Section 3.5.2.3, FPL uses onsite groundwater withdrawn from the Biscayne and Upper Floridan aquifers for a variety of applications in support of Turkey Point Units 3 and 4 operations, as well as for other activities conducted on the Turkey Point site unrelated to Turkey Point Units 3 and 4 operations. Moreover, at the time of initial license renewal as documented in the NRC staff's SEIS for the Turkey Point initial license renewal (NUREG–1437, Supplement 5) (NRC 2002c), no groundwater was being withdrawn for use as makeup water or to support salinity management (i.e., freshening) in the CCS. Since 2014, FPL has substantially increased groundwater usage from both the Biscayne and Upper Floridan aquifers to support freshening of the CCS and, most recently, as part of groundwater extraction activities for remediation of hypersaline groundwater emanating from the CCS.

Conflicts Analysis for the Biscayne Aquifer

In 2017, FPL's groundwater withdrawals from the Biscayne aquifer totaled 8,982.8 mgy (33.8 million m^3/yr). This equates to an average withdrawal of 24.5 mgd (92,700 m^3/d), or approximately 17,000 gpm (64,300 L/min) (see Section 3.5.2.3). Approximately 55 percent of the total volume withdrawn (13.5 mgd (51,100 m^3/day)) from the Biscayne aquifer was associated with testing for the hypersaline groundwater recovery well system, with the remainder (i.e., about 11 mgd (41,800 m^3/yr)) associated with use of the three marine wells (i.e., wells PW-1, SW-1, and SW-2).

FPL did not commence full operation of the recovery well system until May 2018 (Section 3.5.2.2). Consequently, groundwater withdrawals for system development and testing in 2017 do not reflect expected final system production rates. The installed system consists of 10 recovery (extraction) wells that FPL has numbered RW-1 through RW-10. These recovery wells are generally located along the western edge of the CCS. The wells are located and designed to extract hypersaline groundwater from near the base of the Biscayne aquifer, and to limit the influence of CCS operations on the regional saltwater interface. Under optimal conditions, the 10-well system has an extraction capacity of 15 mgd (56,700 m^3/day), or 5,475 mgy (20.7 million m^3/yr).

The SFWMD has issued FPL a water use individual permit (Permit No. 13-06251-W) for operation of the recovery well system. The permit specifies a maximum monthly withdrawal allocation of 465 million gal (1.76 million m^3) (SFWMD 2017a). This limit bounds the total installed production capacity of the recovery wells. Additionally, the permit requires that FPL mitigate interference with existing legal uses of groundwater and mitigate harm to natural resources, including effects on surface water or groundwater that result in lateral movement of the saltwater interface or reductions in the hydroperiod of wetlands or natural water bodies, causes the movement of contaminants contrary to water quality standards, or causes harm to the natural system including habitats for rare or endangered species. In such cases, FPL would be required to reduce or otherwise alter groundwater withdrawals to mitigate impacts.

As referenced above, FPL contracted Tetra Tech (Tetra Tech 2016) to develop and perform numerical groundwater modeling to support FPL's water use permit application to SFWMD. The NRC staff reviewed the modeling report (Tetra Tech 2016) as well the SFWMD report and impacts evaluation that were included in FPL's water use individual permit (Permit No. 13-06251-W) (SFWMD 2017a).

The modeling report assessed various operational scenarios for the recovery well system using a regional, three-dimensional, density-dependent, groundwater flow and saltwater transport model to simulate the effects on conditions in the Biscayne aquifer. As described by Tetra Tech (Tetra Tech 2016) and summarized by FPL (FPL 2018n), the numerical model features an 11-layer flow system to represent the Biscayne aquifer. The model simulates interactions between the CCS, Biscayne aquifer, Biscayne Bay, and affected surface water canals. Seven recovery well scenarios, reflecting differences in recovery well locations, were modeled for a 10-year simulation period, as compared to a "no-action" scenario. The modeling scenario that Tetra Tech (Tetra Tech 2016) identifies as "alternative 3D" represents the recovery well system that has been constructed by FPL. Modeling results for alternative 3D show that the hypersaline plume within the lower high-flow zone of the aquifer will be retracted back to the eastern edge of the CCS within 10 years and that salinity concentrations are reduced to that of seawater (i.e., 35 PSU) or less in the aquifer beneath the CCS. Predicted offsite drawdowns (i.e., west of the L-31E Canal) are less than 0.2 feet (0.06 m) (Tetra Tech 2016).

The modeling results for the constructed well system predict retraction of the westward plume to the edge of the CCS beginning within about 5 years, and complete retraction within 10 years, with minor aquifer drawdown impacts. In the impacts evaluation included in Permit No. 13-06251-W, SFWMD stated that system operation should, as part of the extraction of hypersaline groundwater, pull the saltwater interface in the Biscayne aquifer to the east from its current location and increase the amount of fresh groundwater in areas surrounding the CCS (SFWMD 2017a).

As documented in the SFWMD report issued as part of the permit package for Permit No. 13-06251-W and supporting documentation included in SFWMD's online application file (SFWMD 2017a), SFWMD staff reviewed the modeling submitted by FPL (Tetra Tech 2016) and also performed confirmatory analyses. In summary, SFWMD concluded that: (1) recovery well system withdrawals would have no impact on existing legal users of the Biscayne aquifer, (2) predicted drawdowns would not exceed 0.5 feet (0.15 m) with minimal potential to affect water resource availability given the aquifer's total saturated thickness, and (3) withdrawals should result in eastward retraction of the saltwater interface and increase the availability of fresh groundwater in the area of the CCS. SFWMD separately considered a modeling scenario under drought conditions. The drought scenario predicted a maximum drawdown of less than 0.3 feet (0.09 m) in the Biscayne aquifer west and north of the CCS, resulting in minimal potential to impact sawgrass marsh wetlands in the affected areas.

Consistent with the SFWMD report and the modeling results discussed above, FPL's environmental report predicts retraction of the westward plume to the edge of the CCS by about 5 years and complete retraction within 10 years (i.e., by about 2028), with minor aquifer drawdown impacts. Thus, FPL would achieve the compliance deadline for retraction of the hypersaline plume and its effect on the location of the regional saltwater interface, as set forth in its 2016 consent order with FDEP (FDEP 2016e), without undue impact on groundwater resources or producing unintended groundwater use conflicts. In view of the SFWMD and Tetra Tech conclusions, the NRC staff concludes that recovery well operations to be completed prior to the start of the subsequent license renewal term for Turkey Point (i.e., 2032 for Unit 3 and 2033 for Unit 4), will achieve their intended results. Moreover, even if the groundwater remediation timeframe is extended or delayed, the modeling results and the safeguards imposed by SFWMD through permit conditions provide reasonable assurance that any impacts on groundwater resources and users would be mitigated, while producing beneficial effects on groundwater quality.

The marine wells, which FPL uses to pump seawater into the CCS, have a maximum production capacity of about 45 mgd (170,300 m^3/day). FPL has used the marine wells intermittently since they were installed in 2015 to lower salinity in the CCS under abnormal conditions. For instance, while the marine wells were not used in 2016, FPL diverted marine well water into the CCS during a 6-month period in 2017 (FPL 2018m). Marine well water was most recently used in conjunction with water pumped from the newly operational Upper Floridan aquifer freshening wells (i.e., wells F-1, F-3, F-4, F-5, F-6), to manage CCS salinity levels during an exceptionally dry period. This period of very low rainfall began in November 2016 and lasted through the end of the dry season until September 2017 (FPL 2017a, FPL 2017b, FPL 2018m). While operation of the marine wells does not require a water use permit from SFWMD, their operation is subject to FPL's consent agreement (MDC 2015a) with Miami-Dade County DERM. The agreement specifies that the marine wells may only be used to lower salinity in the CCS under "extraordinary circumstances."

The NRC staff does not expect that periodic use of the marine wells, as might be necessary under abnormal conditions within the CCS, during the period of continued operations extending through the subsequent license renewal term would have any impact on groundwater quality or quantity. The marine wells, located on the Turkey Point peninsula on Biscayne Bay and east of Turkey Point, withdraw saltwater from the upper part of the Biscayne aquifer and would not be expected to impact any wells withdrawing water from the inland portions of the Biscayne aquifer. This is because the permeable Biscayne aquifer in this area is recharged from Biscayne Bay, and periodic well operation would be unlikely to substantially alter groundwater flow in the affected area or result in any substantial drawdown in the Biscayne aquifer.

Conflicts Analysis for the Upper Floridan Aquifer

In 2017, FPL's groundwater withdrawals from the Upper Floridan aquifer totaled 7,137.2 mgy (27.0 million m^3/yr). This equates to an average withdrawal of 19.6 mgd (74,200 m^3/d), or approximately 13,600 gpm (51,500 L/min) (see Section 3.5.2.3). Of the total withdrawn, approximately 13.1 mgd (49,600 m^3/day) was associated with operation of the site's freshening well system (i.e., wells F-1, F-3, F-4, F-5, F-6) for the CCS, with the remainder (i.e., about 6.5 mgd (24,600 m^3/yr)) associated with the use of the three saline production wells (PW-1, PW-3, PW-4).

FPL's modified site certification and associated conditions of certification for the Turkey Point site authorizes the withdrawal of 14.06 mgd (53,200 m^3/day) of groundwater from the upper production zones of the Upper Floridan aquifer for cooling water for Unit 5 and process water for Units 1, 2, 3, 4, and 5 (i.e., from the saline production wells) and an additional 14 mgd (53,000 m^3/day) for CCS salinity reduction (freshening). Thus, FPL's State-issued site certification authorizes a total average daily withdrawal of 28.06 mgd (106,200 m^3/day) from the Upper Floridan aquifer (State of Florida Siting Board 2016, FDEP 2016b) (Section 3.5.2.3).

FPL commissioned the development of a technical evaluation by Tetra Tech (Tetra Tech 2014) in support of FPL's proposed use of Upper Floridan aquifer withdrawals for CCS freshening as part of the 2014 site certification modification effort (FPL 2018n). The East Coast Floridan Aquifer System Model - Phase 2 (ECFAS2) was used to evaluate potential aquifer drawdown and impacts on other groundwater users from the proposed groundwater use. As Tetra Tech documented in its report (Tetra Tech 2014), the original ECFAS2 model is a regional, density-dependent groundwater flow and transport model originally developed for the SFWMD to meet SFWMD's minimum basis of review requirements for water use permitting. The contractor modified and adapted the ECFAS2 model so that the groundwater flow component of the model could be used and calibrated it to current regional conditions (e.g., water levels). Site-specific hydrogeologic conditions were then incorporated into the adapted model by recalibrating the model using two aquifer performance tests performed at Turkey Point. This modified regional model (FPL Floridan model) was used to assess drawdown and potential groundwater use conflicts resulting from the proposed FPL withdrawals at the Turkey Point site and at offsite, regional locations, including potentially affected municipal wellfields (FPL 2018n, Tetra Tech 2014).

As part of the modeling effort, two sets of simulations were run to assess drawdown in the Upper Floridan aquifer commensurate with SFWMD requirements for water use permitting. The first simulation projected drawdown due to sustained withdrawal at the maximum permitted rate from the freshening system wells alone. The second simulation included the freshening system well production in combination with other existing permitted withdrawals (using permitted rates) in the region. Each simulation set considered two scenarios: a base case simulating pumping at wells F-1 through F-5 (no pumping at F-6) and an alternative case simulating pumping at wells F-1 and F-3 through F-6 (no pumping at F-2). In the simulations, the total production volume was distributed evenly among FPL's wells.

First, SFWMD's basis of review for water use permitting requires that the 1-foot (0.3-m) drawdown contour at permitted wells be determined. Based on this criterion, the modeling results obtained from the FPL Floridan model (Tetra Tech 2014) show that operation of FPL's freshening system wells at the maximum permitted rate results in four existing aquifer users falling within the 1-foot (0.3-m) drawdown contour attributable to withdrawals from FPL's salinity reduction wells. These locations include the Sound Golf Club, Ocean Reef Club, Florida Keys Aqueduct Authority, MDWSD South Miami Heights wellfield, and FPL Unit 5 well (PW-1).

A maximum drawdown of 15.1 feet (4.6 m) is predicted to occur on the Turkey Point site (i.e., at salinity reduction well F-3). For offsite, non-FPL wells, the model projects a maximum drawdown of 2.26 feet (0.7 m) at the MDWSD's South Miami Heights wellfield, located approximately 10.3 mi (16.6 km) north, northwest of the center point of FPL's freshening well system. However, the incremental drawdown attributable to FPL freshening well system withdrawals constitutes less than 5 percent of the total predicted cumulative drawdown (i.e., drawdown from all permitted withdrawals from the Upper Florida aquifer) at the South Miami Heights wellfield. In contrast, at the Florida Keys Aqueduct Authority located approximately 10 mi (16 km) to the west, the projected incremental drawdown (i.e., 2.16 feet (0.66 m)) is 12 percent of the total cumulative drawdown. The incremental drawdown contribution is also higher for permitted users that are closer to the Turkey Point site. Specifically, the predicted incremental drawdown (2.21 feet (0.67 m)) at Sound Golf Club and Ocean Reef Club (about 9 mi (14 km) south of the FPL freshening wells) is 19 percent of the total cumulative drawdown. Nevertheless, as documented in the modeling report, the predicted incremental drawdowns are conservative or bounding estimates (i.e., the report overestimates the drawdown due to FPL wells at offsite locations than would likely be observed). In all, the modeling analysis performed demonstrates that operation of FPL's salinity reduction wells (freshening well system) is likely to produce measurable, incremental drawdowns in other offsite Upper Floridan aquifer wells.

Further, the modeling results indicate that operation of the FPL freshening well system would be unlikely to result in any changes to regional water quality, as the Upper Floridan aquifer is already brackish, no saltwater interface exists in the confined system, and water quality changes experienced by other aquifer users have been minor (Tetra Tech 2014). Nonetheless, SFWMD (SFWMD 2012) has documented that wells producing from the Upper Floridan aquifer can experience a degradation in water quality due to vertical seepage (upconing) or lateral movement of more saline water over time.

In accordance with the modified site certification and associated conditions of certification for the Turkey Point site (State of Florida Siting Board 2016, FDEP 2016b), FPL is required to mitigate harm to offsite groundwater users (either related to water quantity or quality) as well as to offsite water bodies, land uses, and other beneficial uses. As necessary, the SFWMD can order FPL to reduce withdrawals or undertake other mitigative actions. FPL is also required to regularly monitor the freshening well system for a number of water quality parameters including TDS and chlorides and report the results to FDEP and Miami-Dade County on a quarterly basis (FDEP 2016b). Additionally, the 2015 consent agreement with Miami-Dade County DERM requires FPL to evaluate alternative water sources for freshening the CCS, including the use of reclaimed wastewater from the County South District Wastewater Treatment Plant, as further described in Section 3.5.2.3 of this SEIS.

Summary of Groundwater Use Conflicts Evaluation

Based on the analyses performed by FPL, the NRC staff's review indicates that current and projected groundwater withdrawals associated with FPL's operation of its Biscayne aquifer marine well and recovery well systems would be unlikely to have any noticeable, adverse impact on any supply wells beyond the confines of the Turkey Point site. This is because drawdowns in the unconfined Biscayne aquifer are projected to be minor and FPL's withdrawals would induce no adverse changes in the Biscayne aquifer or affect other permitted users of the aquifer. Additionally, modeling projections indicate that FPL's operation of the recovery well system will reduce salinity in the Biscayne aquifer and reduce the westward migration of the regional saltwater interface. Recovery well system operations are expected to be completed during the current renewed operating license term, although the NRC staff recognizes that some uncertainty exists regarding the precise time by which the recovery well system will have achieved its objectives.

FPL's continued operation of its Upper Floridan aquifer production wells, particularly the freshening well system, is likely to affect offsite well systems by increasing drawdown in the aquifer beyond that currently being experienced due to regional groundwater production alone. Currently, available information indicates that FPL will need to operate the five CCS freshening wells (i.e., wells F-1, F-3, F-4, F-5, F-6) in addition to its three saline production wells (PW-1, P-3, PW-4) during the subsequent license renewal period of extended operation. The NRC staff finds that the projected drawdowns would noticeably affect the Upper Floridan aquifer, but that FPL's continued withdrawals would not destabilize the groundwater resource or impair the use of the Upper Floridan aquifer by other users and well systems during the period of subsequent license renewal.

Finally, as stated in its environmental report, FPL does not anticipate the need to withdraw groundwater at a rate exceeding its current permits and/or authorizations during the subsequent license renewal period (FPL 2018f). In summary, based on the evaluation presented above, the NRC staff anticipates that operation of the recovery well system will not result in any interference with existing permitted uses of groundwater, will not impact natural resources, and will not result in lateral movement of the saltwater interface in the Biscayne aquifer. Further, intermittent operation of FPL's marine wells is not expected to substantially alter groundwater flow or result in any substantial drawdown in the Biscayne aquifer. For the Upper Floridan aquifer, groundwater modeling performed to evaluate aquifer response from continued operation of FPL's freshening well system indicates the potential for appreciable drawdowns in offsite production wells, including in potable water wells located approximately 10 mi (16 km) from the Turkey Point site. While the projected drawdowns would be noticeable in affected offsite wells, the effects would not be expected to affect water availability or impair the Upper Floridan aquifer as a resource. Consistent with these impacts, the NRC staff concludes that the potential for groundwater use conflicts from FPL's groundwater withdrawals would be SMALL for the Biscayne aquifer and MODERATE for the Upper Floridan aquifer during the subsequent license renewal term.

Radionuclides Released to Groundwater

All commercial nuclear power plants routinely release radioactive gaseous and liquid materials into the environment. These radioactive releases are designed to be planned, monitored, documented, and released into the environment at designated discharge points. In contrast, this issue considers the potential impact to groundwater quality from the unplanned, inadvertent discharge of liquids containing radionuclides into groundwater. Such unknown, uncontrolled, and unmonitored releases of radioactive liquids have occurred at nuclear power plant sites from power plant systems, piping, spent fuel pools, valves, and tanks. The majority of the inadvertent liquid release events involved tritium, which is a radioactive isotope of hydrogen. However, other radioactive isotopes, such as cesium and strontium, have also been inadvertently released into the groundwater at some sites. The inadvertent release of radionuclides to groundwater is a Category 2 issue and requires a plant-specific assessment.

In evaluating the potential impacts on groundwater quality associated with license renewal, the NRC staff uses as its baseline the existing groundwater conditions described in Sections 3.5.2.1 through 3.5.2.3 of this SEIS. These baseline conditions encompass the existing quality of groundwater potentially affected by continued operations (as compared to relevant State or Environmental Protection Agency (EPA) primary drinking water standards), as well as the current and potential onsite and offsite uses and users of groundwater for drinking and other purposes. The baseline also considers other downgradient or in-aquifer uses and users of groundwater.

For the Turkey Point site, FPL participates in the Nuclear Energy Institute's NEI 07-07, "Industry Ground Water Protection Initiative" (NEI 2007), which is focused on actions to improve management and response to the inadvertent release of radioactive substances to subsurface soils and water. Since 2010, FPL has maintained a radiological environmental sampling and analysis program for Turkey Point to meet the recommendations of NEI 07-07. FPL performs groundwater monitoring at 28 onsite locations to monitor for potential inadvertent radioactive releases via potential groundwater pathways at the site in accordance with site procedures. Samples are collected on at least a quarterly basis, or more frequently if deemed necessary. FPL reports the results in annual radiological environmental operating reports and submits these to the NRC.

FPL reports that it has experienced a number of inadvertent releases of radionuclides at Turkey Point with the potential to reach groundwater over the last 5 years, which the NRC staff has reviewed and summarized in Section 3.5.2.2 of this SEIS. Seven such releases were recorded over the period of August 2014 through October 2017. FPL documents such "unplanned" releases in its annual radioactive effluent release reports, which it submits to the NRC. The NRC staff reviewed these reports as part of this environmental review. The releases generally involved water containing tritium as well as other radionuclides including cobalt-58 and sodium-24.

The largest inadvertent release, by liquid volume, involved a sustained release of component cooling water from a leaking heat exchanger, totaling an estimated 4,828 gal (18,280 L). This release occurred during the period from July 26 to September 15, 2015. As discussed in Section 3.5.2.2 of this SEIS, other releases occurred in 2014, 2015, 2017, and 2018, involving substantially smaller releases. In all cases, FPL stopped ongoing releases, surveyed the release area, and increased groundwater sampling in potentially affected areas, as appropriate. FPL documented all such events in the Turkey Point corrective action program, as appropriate.

Table 3-5 in Section 3.5.2.2 of this SEIS summarizes the latest available radiological groundwater monitoring results for Turkey Point and compares the results to historical maximum observed concentrations at each well location. Groundwater monitoring shows that tritium is detectable in underlying groundwater in and around the Turkey Point nuclear island and in areas adjoining the intake and discharge canals. This is not unexpected given the discharge of monitored and permitted effluents containing tritium to the unlined CCS, which is in hydraulic communication with the underlying Biscayne aquifer.

As shown in Table 3-6, in 2017, tritium concentrations in groundwater at Turkey Point ranged from below the minimum detectable concentration to a maximum of 13,600 pCi/L at monitoring well PTN-MW-8S. This maximum tritium level was observed during the fourth quarter of 2017. Monitoring well PTN-MW-8S is located near the Turkey Point Unit 3 refueling water storage tank, between Unit 3 and the cooling water intake canal coming off the CCS (see Figure 3-15). As for plant storm drains, the peak concentration was measured in the southeast storm drain at 13,000 pCi/L. This location is on the south side of the intake canal and east of Unit 3 and monitoring well PTN-MW-8S. As referenced in Section 3.5.2.2, measured tritium in storm drains is heavily influenced by the inflow of water from the CCS.

Surficial groundwater (i.e., the Biscayne aquifer) that has been affected by inadvertent releases within the Turkey Point plant property is classified by the FDEP as Class G-III waters, which means it is neither a current nor potential future source of drinking water. There are no discernible trends in the radiological groundwater protection monitoring results that would indicate either a new inadvertent release or an ongoing inadvertent release of radionuclides to groundwater at Turkey Point. Further, the data indicate that there is no occurrence or migration of tritium in groundwater at concentrations exceeding either the tritium limit (30,000 pCi/L) prescribed by the plant Offsite Dose Calculation Manual (FPL 2013a) or the EPA primary drinking water standard (20,000 pCi/L) (40 CFR 141.16, "Maximum Contaminant Levels for Beta Particle and Photon Radioactivity from Man-Made Radionuclides in Community Water Systems").

Based on the information presented and the NRC staff's review of groundwater monitoring data, the NRC staff finds that inadvertent releases of radionuclides (primarily tritium) have not substantially impaired site groundwater quality within the Biscayne aquifer and have not affected groundwater use beyond the Turkey Point site. Thus, the NRC staff concludes that groundwater quality impacts from inadvertent releases of radionuclides are SMALL and are projected to remain SMALL during the subsequent license renewal term.

4.5.2 No-Action Alternative

4.5.2.1 Surface Water Resources

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed operating licenses. During shutdown, there would not be any surface water consumption or offsite discharges to surface water bodies. All liquid discharges from the shutdown facility, including storm water, would continue to flow into the CCS. Other facilities at the Turkey Point site would continue to discharge to the CCS, including cooling tower blowdown from Unit 5. Water from the CCS would continue to be circulated through retired fossil fuel Units 1 and 2. However, this circulation would not add heat to the CCS.

After shutdown, the temperature of water within the CCS would be much lower and the rate of evaporation of water from the CCS would decrease. The NRC staff expects that FPL would continue to implement State- and County-required programs to reduce salinities and to control ammonia and nutrients within the CCS, until the desired objectives are achieved. These actions would reduce the potential for waters from the CCS to impact surface water bodies via the groundwater pathway. Therefore, the NRC staff concludes that the impacts to surface water resources from the no-action alternative would be SMALL.

4.5.2.2 Groundwater Resources

Miami-Dade Water and Sewer Department (MDWSD) supplies potable water to Turkey Point for process water makeup, potable uses, and fire protection uses. The source of this water is groundwater pumped from the Biscayne aquifer. With the cessation of operations, FPL's use of potable water at Turkey Point for these uses would be greatly reduced but would not likely cease until sometime during decommissioning. Similarly, FPL's use of groundwater from the Upper Floridan aquifer to supply water for Turkey Point uses would also likely be reduced as a result of shutdown and would eventually cease.

Sanitary wastewater discharges to the Boulder Zone via Turkey Point's injection well and septic systems would also be reduced as the plant workforce is drawn down.

As described in Section 4.5.2.1 of this SEIS, shutdown of Turkey Point would entail a gradual reduction and eventual cessation of condenser cooling water and service water withdrawals from, and return discharges to, the CCS. However, the NRC staff expects that the CCS would continue to receive effluent discharges from Turkey Point Unit 5 for the foreseeable future as well as stormwater runoff from the Turkey Point plant complex and from the balance of the Turkey Point site. Consequently, water in the CCS would continue to be exchanged with groundwater in the underlying Biscayne aquifer.

The shutdown of Turkey Point would substantially reduce thermal discharges to the CCS as well as cooling water and other effluents from the plant's cooling water system. This flow reduction would reduce groundwater mounding (i.e., a localized increase in the water table) beneath the CCS and reduce the generation of hypersaline water. As a result, the amount of water used to support freshening activities in accordance with the provisions of FPL's 2015 consent agreement with Miami-Dade County DERM (MDC 2015a) and the 2016 FDEP consent order (FDEP 2016e) could be reduced. Currently, the principal source of water for salinity management (i.e., freshening) in the CCS and for reducing the generation of hypersaline groundwater beneath the CCS is derived from five production wells tapping the Upper Floridan aquifer. These withdrawals are described in Section 3.5.2.3 of this SEIS and are evaluated in Section 4.5.1.2 above. Nevertheless, with the shutdown of Turkey Point, the NRC staff expects that some use of water by FPL for salinity management in the CCS would continue, possibly at a reduced rate.

Based on the above considerations, the NRC staff concludes that the overall impact of the no-action alternative on groundwater resources would be SMALL.

4.5.3 Replacement Power Alternatives: Common Impacts

4.5.3.1 Surface Water Resources

For all replacement power alternatives considered, the NRC staff assumes that surface water resources would not be consumed and liquid discharges to adjacent surface water bodies would not be allowed during both construction and operation. During construction, all water from dewatering and other activities would be discharged into the CCS. During operations, cooling tower blowdown and radiological liquid discharges would be deep well injected into the Boulder Zone of the Floridan aquifer. Stormwater would be discharged into the CCS.

As discussed in the no-action alternative, under a replacement power alternative, the CCS would no longer be used for cooling by Units 3 and 4 or by any of the replacement power alternatives evaluated. Consequently, the potential for impacts from the CCS on adjacent surface water bodies via the groundwater pathway would be reduced. Therefore, the NRC staff concludes that the common impacts on surface water resources would be SMALL.

4.5.3.2 Groundwater Resources

<u>Construction</u>

Construction activities associated with thermoelectric power facilities at the Turkey Point site would likely require groundwater dewatering, especially of deep excavations associated with emplacement of facility foundations and substructures. This would require the use of cofferdams, sheet pilings, sumps, wells, or other methods to address high water-table conditions. Use of crushed limestone fill at construction sites would reduce the relative depth of excavation work and would minimize post-construction impacts.

Excavation work and dewatering would affect the Biscayne aquifer. As previously evaluated by the NRC staff for the construction of Turkey Point Units 6 and 7, dewatered areas of the aquifer would be quickly recharged locally from surface-water features including the cooling canals, Biscayne Bay, the L-31E Canal, aquifer inflow, and infiltration of rainfall. It is possible that dewatering could induce groundwater flow from the inland portion of the aquifer through deeper permeable layers and toward the dewatering points. However, the volume of inland groundwater captured would be very small (NRC 2016a). Dewatering at the rates (400 to 1,200 gpm (1,500 to 4,500 L/min) projected in Section 4.2.1 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) would require a water use permit issued by the South Florida Water Management District (SFWMD) (FAC 40E-2). The NRC staff expects that any impacts on groundwater flow and quality within the portions of the Biscayne aquifer affected by dewatering would be highly localized and of short duration, with minor effects on other aquifer users.

Once extracted, groundwater would be managed in accordance with Florida Department of Environmental Protection (FDEP) requirements. For example, discharge of extracted groundwater would be governed by conditions specified in an FDEP-issued NPDES general (generic) permit for stormwater discharge from large and small construction activities (FDEP 2018a, FPL 2018f). Dewatering flows could also be discharged to the CCS, which would likely require a modification of the applicant's NPDES permit (i.e., industrial wastewater facility permit). A similar scenario was previously evaluated by the NRC staff in Section 4.2.1.4 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176). There, the NRC staff evaluated a maximum discharge rate to the CCS of 1,200 gpm (450 L/min), equivalent to 1.7 mgd (6,500 m^3/day) over an assumed dewatering period of 1 year. In summary, the NRC staff determined that such a discharge rate would generally not be detectable in the CCS as that rate of discharge would equate to about 0.06 percent of the recirculating flow rate of the CCS. The NRC staff further concluded that the impacts on groundwater quality, including from additional seepage from the CCS, would be minor (NRC 2016a).

Construction of replacement power generating facilities at the Turkey Point site would increase the amount of impervious surface as well as alter the subsurface strata because of excavation work and the placement of backfill following facility completion. While an increase in impervious surface would reduce infiltration and reduce groundwater recharge, the effects on water-table elevations in the underlying Biscayne aquifer would likely be very small given the relatively small surface area affected and the high permeability of the aquifer. Below-grade portions of new power generating facilities at the site could alter the direction of groundwater flow. Such effects would likely be localized, and the NRC staff does not expect them to affect offsite groundwater users or adjacent surface water bodies, including Biscayne Bay.

Application of best management practices in accordance with a stormwater pollution prevention plan developed for the FDEP-issued NPDES generic permit, including appropriate waste management, water discharge, and spill prevention practices, would prevent or minimize any areawide groundwater quality impacts during construction.

The construction of additional onsite underground injection wells and associated monitoring wells may be necessary to support the disposal of effluent streams from operations. Such wells could also be used to dispose of any wastewaters generated during facility construction. In association with the construction of Turkey Point Units 6 and 7, the NRC staff evaluated the construction of 10 underground injection wells, 2 backup wells, and 6 dual-zone monitoring wells. The wells would be more than 3,000-feet (914-m) deep and completed in the

Boulder Zone of the Lower Floridan aquifer. Construction of these wells would be subject to FDEP Class I industrial waste underground injection control permits (FAC 62-528). In Section 4.2.3 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176), the NRC staff determined that activities related to the construction of injection wells and monitoring wells in the Boulder Zone would have negligible effects on groundwater quality in the surficial Biscayne aquifer and the deeper Floridan aquifer system (NRC 2016a).

Water would be required for such uses as dust control and soil compaction, as well as to meet the drinking and sanitary needs of the construction workforce during the construction period for all facilities. The use of portable sanitary facilities, serviced by a commercial vendor, would serve to reduce water use and sanitary wastewater generation by the construction workforce. Consistent with the assumptions in FPL's environmental report submitted as part of this subsequent license renewal application and as previously considered in the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), the NRC staff assumes that water would be obtained from the Miami-Dade Water and Sewer Department (MDWSD). The principal water source for the MDWSD is the Biscayne aquifer. The NRC staff projects that maximum water use to support construction would be approximately 0.8 mgd (3,000 m^3/day). The volume of water required would be a very small percentage of the capacity of the County system (NRC 2016a).

Operation

Post-construction groundwater dewatering may be required during the operational period of the onsite power generating facilities. Dewatering rates would be much lower than those projected for the construction period. Operational dewatering would be subject to water use permitting requirements administered by the South Florida Water Management District (SFWMD) (FAC 40E-2). Once extracted, groundwater would be managed in accordance with FDEP requirements, including applicable NPDES permitting requirements.

Onsite thermoelectric power generating facilities would use mechanical draft cooling towers for condenser cooling. For the purposes of analysis and as referenced in Section 2.2 of this SEIS, the NRC staff assumes that these cooling towers would be similar to those previously described in Section 3.4.2.2 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a). The source of makeup water would be reclaimed wastewater supplied by the MDWSD (see Table 2-1). The NRC staff assumes that no groundwater would be directly used to support replacement power generating facilities.

Replacement power facilities would also require freshwater for general service water, fire protection, demineralized water makeup, and potable and sanitary use. The NRC staff assumes that this water would be obtained from MDWSD via an existing right-of-way and/or a proposed new supply pipeline to the Turkey Point site as described in Section 3.2.3 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a).

The onsite thermoelectric power generating facilities would produce cooling tower blowdown, treated radiological wastewater, sanitary wastewater, and other effluent streams. Consistent with the assumptions in the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), the NRC staff assumes that these effluent streams would be disposed of via underground injection wells to the Boulder Zone. Disposal would occur via the same or similar wells as proposed for use in support of Unit 6 and 7 operations. Any new wells would be constructed and operated in accordance with underground injection control permits issued by the FDEP (FAC R62-528).

In Sections 3.4.2, 5.2.1.3, 5.2.3, and 5.8 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), the NRC staff evaluated the deep well injection of up 90 mgd (341,000 m^3/day) of cooling water blowdown and other liquid waste streams from proposed Units 6 and 7. The NRC staff concluded in part that proper well design and isolation of the Boulder Zone by low-permeability strata would prevent degradation of overlying underground sources of drinking water. The Boulder Zone deep injection wells would be permitted by FDEP. This permit would require FPL to implement institutional controls and monitoring programs to detect upward migration of injected wastewater. As a result, the NRC staff concluded that operational groundwater-quality impacts would be SMALL (NRC 2016a).

It is expected that stormwater runoff from onsite thermoelectric power generating facilities would be conveyed to the CCS. Use of the CCS would require that FPL modify its NPDES permit (i.e., industrial wastewater facility permit) for operation of the facility. Since the CCS is in hydraulic communication with the underlying Biscayne aquifer, any pollutants in stormwater runoff could reach groundwater. Nevertheless, as facility operations would be subject to pollution prevention and best management practices required by FDEP, the NRC staff considers potential water quality impacts on groundwater quality to be minimal.

4.5.4 New Nuclear Alternative

4.5.4.1 Surface Water Resources

The NRC staff did not identify any impacts to surface water resources for this alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to surface water resources from this alternative would be SMALL.

4.5.4.2 Groundwater Resources

Groundwater use and quality impacts from construction and operations associated with the new nuclear alternative would likely be similar to but somewhat less than those described and assumed as common to all alternatives in Section 4.5.3.2. This is due to the reduced construction footprint and operational impacts. The staff projects that the use of reclaimed wastewater for cooling tower makeup and the generation of cooling tower blowdown and other effluents would be reduced by about 30 percent, as compared to the proposed Turkey Point Units 6 and 7. This would produce cooling tower blowdown along with other effluents at a rate of approximately 9 mgd (34,100 m^3/day). These wastewaters would be disposed of by deep well injection into the Boulder Zone beneath the Turkey Point site (see Section 4.5.3.2). Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operations associated with the new nuclear alternative would be SMALL.

4.5.5 Natural Gas Combined-Cycle Alternative

4.5.5.1 Surface Water Resources

The NRC staff did not identify any impacts to surface water resources for this alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to surface water resources from the natural gas combined-cycle alternative would be SMALL.

4.5.5.2 Groundwater Resources

Groundwater use and quality impacts from construction activities and operations associated with the natural gas combined-cycle alternative would be much smaller than those described in Section 4.5.3.2. This is because less extensive excavation work and associated dewatering would be required for construction. As for operations, the NRC staff projects that cooling water demand associated with operation of cooling towers and the generation of blowdown and other effluent streams would be reduced by approximately 80 and 70 percent, as compared to the proposed Turkey Point Units 6 and 7 and new nuclear alternative, respectively, given the comparatively lower level of cooling needed for the natural gas plant. This would produce cooling tower blowdown along with other effluents at a rate of approximately 2.4 mgd (9,100 m^3/day), which would be disposed of by deep well injection into the Boulder Zone (see Section 4.5.3.2).

Construction of a new natural gas pipeline would result in additional ground-disturbing impacts and the need for dewatering areas around pipeline pad and pier supports. However, any groundwater impacts would likely be localized and temporary.

For this alternative, the NRC staff concludes that the impacts on groundwater resources from construction and operations would be SMALL.

4.5.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

4.5.6.1 Surface Water Resources

The NRC staff did not identify any impacts to surface water resources for this alternative, beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to surface water resources from this alternative would be SMALL.

4.5.6.2 Groundwater Resources

Groundwater use and quality impacts from construction activities and operations associated with the onsite natural gas combined-cycle component of this alternative would be very similar to those referenced in Section 4.5.5.2. This is because the construction and operational aspects of the natural gas combined-cycle power plant would be similar.

The NRC staff expects that there would be little or no groundwater use or groundwater quality impacts for construction and operations of the onsite and offsite solar facilities. This is because groundwater dewatering would likely be minimal due to the relatively small footprint of pad sites, access roads, and utility corridors where excavation, grading, and trenching might be required.

Based on the above, the NRC staff concludes that the overall impacts on groundwater resources from construction and operations associated with the combination alternative would be SMALL.

4.5.7 Cooling Water System Alternative

4.5.7.1 Surface Water Resources

The NRC staff did not identify any impacts to surface water resources for this alternative beyond those discussed above as common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts to surface water resources from this alternative would be SMALL.

4.5.7.2 Groundwater Resources

No onsite groundwater would be required to support cooling tower construction. Water would be required for such uses as dust control, soil compaction, as well as to meet the drinking and sanitary needs of the construction workforce during the construction period for all facilities. Consistent with the assumptions in the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), the NRC staff assumes that water for such uses would be obtained from the Miami-Dade Water and Sewer Department (MDWSD), which primarily uses the Biscayne aquifer as a water source. The NRC staff expects that construction water would be trucked to the point of use as needed from onsite service connections with MDWSD. Onsite water demands to support cooling tower construction could be reduced by the use of ready-mix concrete and the use of portable sanitary facilities for construction workers that are serviced offsite.

Groundwater dewatering would likely be required in excavations associated with below-grade portions of the cooling towers. Construction activities would include the use of cofferdams, sheet pilings, sumps, wells, or other methods to address high water-table conditions as they exist at the Turkey Point site. Depending on the rate and duration of dewatering activities, dewatering activities would have to be permitted under a SFWMD-issued water use permit or, more likely, under a general permit-by-rule for temporary dewatering (FAC 40E-2). The NRC staff expects that any impacts on groundwater flow and quality within the portions of the Biscayne aquifer affected by dewatering would be highly localized and of short duration, with minor effects on other aquifer users.

Once extracted, the NRC staff assumes that groundwater would be properly managed in accordance with FDEP requirements. Specifically, an FDEP-issued NPDES general (generic) permit for stormwater discharge from large and small construction activities would govern the discharge of extracted groundwater and all ground-disturbing activities. The construction contractor would be required to implement best management practices and other controls (including appropriate waste management, water discharge, and spill prevention practices) under a stormwater pollution prevention plan (FDEP 2018a). These would serve to mitigate any impacts on groundwater quality during construction.

During commissioning of the cooling water system alternative, Turkey Point may be offline for a period of time. Groundwater production on the Turkey Point site associated with the operation of the five CCS freshening wells (F-1, F-3, F-4, F-5, F-6) withdrawing from the Upper Floridan aquifer and the three saline production wells (PW-1, PW-3, PW-4) would be expected to continue during the transition period at current rates.

As described in Section 4.5.2.2 for the no-action alternative, the NRC staff expects that the CCS would continue to operate under this alternative and would receive cooling tower blowdown and other effluents and runoff from Turkey Point Unit 5 as well as stormwater from the Turkey Point plant complex and other FPL facilities. While the NRC staff expects that groundwater demands for CCS freshening would decrease over time commensurate with the reduction in thermal discharge to the CCS from Turkey Point Units 3 and 4, some use of groundwater (or other water sources) would likely continue into the future. The NRC staff expects that the volume of water needed for CCS freshening will be governed by the provisions of FPL's 2015 consent agreement with Miami-Dade County DERM (MDC 2015a) and the 2016 FDEP consent order (FDEP 2016e), recognizing that those requirements are subject to possible modification in the future.

No onsite groundwater or MDWSD-supplied groundwater would be used during operation of the Turkey Point cooling water system alternative, as the cooling towers would be supplied by treated, reclaimed wastewater. Otherwise, onsite use of MDWSD-supplied groundwater from the Biscayne aquifer for Turkey Point potable water and fire protection use would be similar to the volumes used during the current renewed license period.

Operation of the mechanical-draft cooling towers for condenser cooling would produce cooling tower blowdown at a projected rate of 11 mgd (41,600 m^3/day). This effluent stream would contain cooling water treatment and conditioning chemical residuals (e.g., biocides, corrosion inhibitors) necessary for proper operation and maintenance of the cooling towers and Turkey Point Units 3 and 4 circulating water system. Additionally, Turkey Point Units 3 and 4 operations would continue to produce various process water effluents, including liquid radwaste effluents. The NRC staff assumes that these effluents would be disposed of by deep well injection into the Boulder Zone, which would be regulated under a Class I underground injection control permit issued by the FDEP (FAC 62-528).

As referenced in Section 4.5.3.2, the NRC staff previously evaluated the deep well injection of up 90 mgd (341,000 m^3/day) of cooling water blowdown and other liquid waste streams from proposed Turkey Point Units 6 and 7. The NRC staff concluded in part that proper well design and isolation of the Boulder Zone by low-permeability strata would prevent degradation of overlying underground sources of drinking water. The Boulder Zone deep injection wells would be permitted by FDEP, and FPL would be required to implement institutional controls and monitoring programs to detect upward migration of injected wastewater. As a result, the NRC staff concluded that operational groundwater-quality impacts would be SMALL (NRC 2016a). The NRC staff finds that the disposal of effluents by deep well injection of effluents under this alternative would be bounded by the cited analysis.

In consideration of the information and assumptions presented above, the NRC staff concludes that the impacts on groundwater resources from construction and operation of the closed-cycle cooling alternative would be SMALL.

4.6 Terrestrial Resources

This section describes the potential terrestrial resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.6.1 Proposed Action

As identified in Table 4-1, "Applicable Category 1 (Generic) Issues for Turkey Point," in Section 4.1 of this chapter, the impacts of all generic terrestrial resource issues would be SMALL. According to the GEIS (NRC 1996 and 2013a), terrestrial resources would not be significantly affected by continued operations associated with license renewal. For the terrestrial resource issues addressed in the 2013 GEIS, no new and significant information was identified that would alter the GEIS conclusions for Category 1 issues for Turkey Point subsequent license renewal. New information related to one of these categories, “Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds),” is discussed below. Also, in Section 4.1 of this chapter, Table 4-2, “Applicable Category 2 (Site-Specific) Issues for Turkey Point,” identifies one site-specific (Category 2) issue related to terrestrial resources during the subsequent license renewal term. That issue is also analyzed below.

<u>New Information, Category 1 Issue, Cooling System Impacts on Terrestrial Resources (Plants with Once-Through Cooling Systems or Cooling Ponds)</u>

As referenced in Section 1.4 of this SEIS and as further described under Sections 1.5 and 1.8 of the GEIS (NUREG-1437) (NRC 2013a), no additional site-specific analysis is required by the NRC staff for Category 1 (generic) issues in the SEIS unless new and significant information is identified that would change the conclusions in the GEIS. Where new and significant information has been identified, the NRC staff would reconsider generic impacts in the SEIS.

The Category 1 issue, “Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds),” was first evaluated in the 1996 GEIS (NRC 1996) under the name, “Cooling pond impacts on terrestrial resources.” This issue was modified and renamed as part of the 10-year update to the GEIS, which was issued in June 2013 (NRC 2013a).

For the subject issue, the 2013 GEIS (NRC 2013a: 4-64 - 4-69) considers potential impacts to terrestrial resources from contaminants and physical alterations of the environment resulting from cooling system operations. As a part of the analysis, the 2013 GEIS describes several site-specific examples of plants with cooling ponds and the NRC staff’s conclusions regarding the effects on terrestrial resources as documented in site-specific SEISs, including the potential effects from the CCS at Turkey Point. The 2013 GEIS (NRC 2013a: page 4-68) specifically states the following:

> Groundwater quality can be degraded by contaminants present in cooling ponds and cooling canals. Deep-rooted terrestrial plants could be exposed to these contaminants. In addition, biota could be exposed to contaminants at locations of groundwater discharge, such as wetlands or riparian areas. However, as noted above, contaminant concentrations are typically very low, and any effects on terrestrial plants would be expected to be SMALL. Mitigation may also be implemented where sensitive resources could be affected. At the Turkey Point plant in Florida, for example, the flow of hypersaline groundwater from the cooling canals toward the Everglades to the west is prevented by an interceptor ditch, located along the west side of the canal system, from which groundwater inflow is extracted (NRC 2002b).

Since publication of the 2013 GEIS, new information has indicated that the interceptor ditch has not prevented groundwater migration west of the CCS. Section 3.6 of this SEIS presents and considers relevant new information related to terrestrial resources at the Turkey Point site concerning the subject issue. Specifically, Section 3.6.1 summarizes the results from FPL’s vegetative survey monitoring plan, which was required as a condition of its site certification from the State of Florida (FPL 2018g). With respect to sawgrass (the most common species in sawgrass marshes), Section 3.6.1 states that the seasonal and annual changes in sawgrass height and live biomass were generally similar between the reference transect (T6), chosen for being farther from the CCS, and transects that are closer to the CCS (T1–T4). The surveys show that wetlands at different distances from the CCS exhibit similar growth trends. These patterns suggest that landscape-scale environmental factors, such as the length of the hydroperiod or overall water depth, have a greater effect on changes in live biomass and sawgrass height than proximity to 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. Therefore, even in light of the new information that the hypersaline groundwater plume flows past the interceptor ditch, the most currently available information described in Section 3.6.1 of this SEIS suggests that operation of the CCS does not have a noticeable impact on wetlands or any other important attribute of the terrestrial resources on or near Turkey Point. In conclusion, the NRC staff has determined that the new information available since the publication of the 2013 GEIS is not significant because it does not change the findings in the 2013 GEIS for the Category 1 issue related to "Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)."

4.6.1.1 Category 2 Issue Related to Terrestrial Resources: Effects on Terrestrial Resources (Non-Cooling System Impacts)

According to the GEIS (NUREG-1437), non-cooling system impacts on terrestrial resources can include those impacts that result from landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the subsequent license renewal period on or near a plant site.

<u>Landscape Maintenance and Operational Activities</u>

FPL's (FPL 2018f; FPL 2018g) landscape maintenance and operational activities during the subsequent license renewal term would remain similar to those currently conducted. These activities primarily consist of mowing, string trimming, hedge trimming, 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. FPL does not anticipate performing refurbishment during the subsequent license renewal period (FPL 2018f).

Within developed portions of the site—such as near the power block, administrative buildings, and transmission lines and associated infrastructure—landscape activities generally include vegetative trimming and mowing, herbicide application, and infrastructure maintenance and repair. Herbicide treatment would primarily occur in areas connecting the collector yard to the switch yard. FPL (FPL 2018f) applies commercially approved herbicides in accordance with its Florida site certification application and applicable Federal and State regulations. For example, FPL must notify the Florida Department of Environmental Protection (FDEP) Southeast District of the Department of Siting Coordination Office at least 60 days prior to the first use of an herbicide. Herbicide treatment, vegetative trimming and mowing, and infrastructure maintenance in these areas could disturb or displace wildlife and birds. However, most wildlife near these areas are likely relatively tolerant of human activity given the current level of operational activities onsite. Any wildlife that become disturbed or displaced when landscape activities occur would be able to find similar habitat onsite or nearby. In addition, the displacement period would be limited to a few hours or days.

Within less-developed portions of the site that contain high-quality terrestrial habitats—such as freshwater wetlands, mangroves, or wooded areas—ground-disturbing maintenance activities 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. FPL annually removes exotic species, such as Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*), from within CCS canals and berms and along the access and CCS perimeter roads. FPL removes such species using an amphibious excavator backhoe and a D-3 Dozer, piling the vegetation on the CCS berms and then burning the vegetation in accordance with the FPL burn permit issued by the Florida Department of Agriculture and Consumer Services (FDACS) Permit 1373498 (FPL 2018g). Removal occurs along berms that provide habitat for federally protected species (American crocodile (*Crocodylus acutus*)), State-protected species (least terns (*Sterna antillarum*)), and other wildlife and birds. Within areas that FPL has defined as crocodile sanctuaries, 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. Although removal and burning could disturb wildlife 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, and that work in or around active American crocodile nests sites is prohibited from March to August. These and other potential impacts on the American crocodile are addressed in detail in Section 4.8.1.1 of this SEIS, "Species and Habitats Protected Under the Endangered Species Act," and in the NRC staff's Biological Assessment (NRC 2018n). Wildlife and birds would likely be displaced during such activities. However, displacement would be limited to the short duration of the activity and similar habitat would be accessible both on and within the vicinity of the site. In addition, the removal of the exotic species promotes the growth of native and rare species.

Environmental impacts from landscape maintenance and operational activities would also be minimized because FPL maintains environmental control procedures for any activities that result in the clearing of land, excavation, or other activity that would alter the physical environment or ecology of the site (FPL 2018f and FPL 2018g). FPL's procedures direct personnel to obtain appropriate local, State, or Federal permits (or some combination of the three) before beginning work; implement best management practices to protect wetlands, natural heritage areas, and sensitive ecosystems (see the paragraph below, "Stormwater Management"); and consult the appropriate agencies wherever federally or State-listed species may be affected. Turkey Point's Environmental Protection Plan contained in Appendix B of the current renewed operating licenses requires FPL to prepare an environmental evaluation for any construction or operational activities which may significantly affect the environment (NRC 2002a). If such an evaluation indicates that an activity involves an unreviewed environmental question, the Turkey Point Environmental Protection Plan requires that FPL obtain approval from the NRC before performing the activity (NRC 2002d). The subsequent renewed licenses, if issued, would include an environmental protection plan with identical or similar requirements.

<u>Stormwater Management</u>

Stormwater runoff from impervious surfaces can change the frequency or duration of inundation and soil infiltration within wetlands, mangroves, and neighboring terrestrial habitats. Effects of stormwater runoff may include erosion, altered hydrology, sedimentation, and other changes to plant community characteristics. Runoff may contain sediments, contaminants and oils from road or parking surfaces, or herbicides. At Turkey Point, stormwater collected in drainage channels and floor drains is discharged directly to the CCS. Turkey Point does not discharge stormwater directly into Biscayne Bay or any other 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. FDEP regulations require a stormwater permit and Stormwater Pollution Prevention Plan for any construction activities or activities that would result in the clearing of land, excavation, or other action that would alter the physical environment or ecology of the site. FPL's Stormwater Pollution Prevention 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 2018g). The 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 that are utilized to minimize the frequency and severity of oil spills (FPL 2018f). Collectively, these measures ensure that the effects to terrestrial resources from pollutants carried by stormwater would be minimized during the proposed subsequent license renewal term.

Noise

The GEIS (NUREG-1437) (NRC 2013a) states that elevated noise levels from transformers and other equipment could disrupt wildlife behavioral patterns or cause animals to avoid such areas. However, limited wildlife occurs in areas of the Turkey Point site with elevated noise levels due to the developed nature of those portions of the site, associated lack of high-quality habitat, and regular presence of human activity. Wildlife that does occur in developed areas is likely tolerant of disturbance due to decades of operations. Therefore, noise associated with the continued operation of transformers and other plant equipment during the proposed subsequent license renewal term is unlikely to create noticeable impacts on terrestrial resources.

Conclusion

Based on the NRC staff's independent review, the staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that FPL might undertake during the subsequent license renewal term would primarily be confined to already-disturbed areas of the Turkey Point site. Within less-developed portions of the site, disturbances to wildlife would be minimal, and wildlife could use similar habitat nearby during the limited periods of the disturbance. Therefore, these activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the Turkey Point site. Accordingly, the NRC staff concludes that non-cooling system impacts on terrestrial resources during the subsequent license renewal term would be SMALL.

4.6.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed licenses. Some impacts on terrestrial resources would cease following reactor shutdown while other impacts may continue to exist at a reduced level. For example, noise impacts and impacts associated with herbicide application and landscape maintenance could continue for some time following reactor shutdown depending on the level at which FPL continues to maintain landscaped areas. Other impacts on terrestrial resources would be the same as if the plant were still operating, such as the potential for bird collisions with plant structures and transmission lines. The CCS would continue to operate under the no-action alternative because it supports retired fossil fuel Units 1 and 2. FPL plans to continue to withdraw water from the CCS to support these units' operation in synchronous condenser mode over the course of the proposed subsequent license renewal period, as described in Section 3.1.3, “Cooling and Auxiliary Water Systems.” Additionally, Unit 5, which remains in operation, discharges blowdown to the CCS. CCS conditions could change under the no-action alternative because less heat would be discharged to the system, which would potentially make conditions less saline and more favorable for birds and wildlife; on the other hand, flow would likely decrease following shutdown because Turkey Point Units 3 and 4 would not require as much water, and less flow could lead to stagnant conditions, which may be less favorable for birds and wildlife. Regardless, FPL would continue CCS restoration activities, as described in Section 3.7, “Aquatic Resources.” The State of Florida requires these activities under FPL’s Nutrient Management Plan which is independent of subsequent license renewal. As described in Section 4.5.2.1 of this SEIS, the CCS would likely continue to provide wildlife habitat for foraging and breeding. Thus, shutdown itself is unlikely to noticeably alter or have more than minor effects on terrestrial resources. The NRC staff concludes that the impacts of the no-action alternative on terrestrial resources during the proposed subsequent license renewal term would be SMALL.

4.6.3 Replacement Power Alternatives: Common Impacts

Construction

Each replacement power alternative would entail construction and operation of a new energy generating facility on FPL’s existing Turkey Point site or the surrounding area and would result in qualitatively similar impacts to terrestrial resources. During construction of a replacement power facility, the use of the Turkey Point site would allow FPL to maximize existing buildings and infrastructure. However, due to the prevalence of important terrestrial habitats onsite—such as freshwater wetlands, mangroves, and wooded habitats—it is unlikely that FPL would be able to avoid impacting sensitive and important terrestrial habitats. Impacts from construction could result in both the permanent and temporary loss of important terrestrial habitats, habitat fragmentation, and habitat degradation as a result of runoff, erosion, and sedimentation, depending on the specific areas used for construction. Wildlife and birds would likely avoid the area during the construction of a replacement power facility due to noise and other disturbances. Collisions with tall structures and vehicles could also result in wildlife and bird mortality. Implementation of appropriate best management practices, revegetation following construction, and required compensatory mitigation for unavoidable wetland impacts would minimize such impacts.

Operation

In the GEIS (NUREG-1437) (NRC 2013a), the NRC staff concluded that for all nuclear power plants, impacts to terrestrial resources from operation of nuclear and fossil-fueled plants would be similar and would include cooling tower salt drift, noise, bird collisions with plant structures and transmission lines, as well as impacts connected with herbicide application and landscape management. Additional impacts to terrestrial resources during the operational period could occur as a result of offsite mining, extraction, or waste disposal activities associated with each plant’s particular type of fuel.

4.6.4 New Nuclear Alternative

The NRC staff did not identify any impacts on terrestrial resources for the new nuclear alternative beyond those discussed in the impacts common to all replacement power alternatives. However, the common impact onsite could be slightly more intense for the new nuclear alternative as compared to the natural gas alternative. This can be attributed to the larger land area required for the new nuclear power block, which could result in increased erosion and potential introduction of sediments to wetland habitats. In addition, given the prevalence of wetlands within the Turkey Point site, it is unlikely that FPL would be able to avoid permanently filling or disturbing wetlands when siting the new nuclear alternative. Given that the construction of the new nuclear alternative would result in the permanent disturbance, fragmentation, and degradation of up to 360 ac (150 ha) of important terrestrial habitats, the NRC staff concludes that the impacts to terrestrial resources from construction and operation of a new nuclear alternative would be MODERATE.

4.6.5 Natural Gas Combined-Cycle Alternative

The onsite impacts on terrestrial resources would be less intense for construction of a natural gas plant as compared to a new nuclear plant because the natural gas plant would disturb less land. However, the natural gas alternative would also require construction of a 1,200-ac (490-ha) long right-of-way for a gas pipeline, which could result in the loss, modification, and fragmentation of important terrestrial habitats. Collocation of the right-of-way with other existing rights-of-way would minimize the amount of habitat disturbance. The natural gas alternative would also emit pollutants that could degrade wetland and other important habitats. The NRC staff concludes that the impacts of constructing and operating the natural gas alternative on terrestrial resources would be MODERATE due to the permanent disturbance, fragmentation, and degradation of important terrestrial habitats.

4.6.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

The NRC staff did not identify any impacts to terrestrial resources for the natural gas portion of the combination alternative beyond those described for the natural gas-only alternative. For the solar portion of the combination alternative, the exact level of disturbance to terrestrial habitats and biota would depend on the amount of land required for each unit and the specific siting of buildings and infrastructure within the site footprint. Due to the prevalence of important terrestrial habitats within the areas where the solar units would be sited, it is likely that construction would result in the temporary and permanent disturbance, fragmentation, and degradation of important terrestrial habitats. The NRC staff concludes that the impacts of implementing the combination alternative on terrestrial resources would be MODERATE during construction and operation due to the impact on important terrestrial habitat.

4.6.7 Cooling Water System Alternative

The NRC staff did not identify any impacts on terrestrial resources for the cooling water system alternative beyond those discussed in the impacts common to all replacement power alternatives. In addition, the common impacts would be less intense for the cooling water system alternative due to the smaller land area required for construction and operation. Nonetheless, construction would likely result in the temporary or permanent disturbance, fragmentation, and degradation of important terrestrial habitats. The NRC staff concludes that the impacts to terrestrial resources from construction and operation of a cooling water system alternative would be MODERATE due to the noticeable impacts from the permanent disturbance, fragmentation, and degradation of important terrestrial habitats.

4.7 <u>Aquatic Resources</u>

This section describes the potential aquatic resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.7.1 Proposed Action

As identified in Table 4-1, "Applicable Category 1 (Generic) Issues for Turkey Point," in Section 4.1 of this chapter, the impacts of all generic aquatic resource issues would be SMALL. The NRC staff analyzed Category 1 issues in the GEIS (NRC 2013a) and determined that the impacts of continued nuclear power plant operation during a license renewal term would have SMALL effects for these issues. The NRC staff has identified no new or significant information for aquatic resource Category 1 issues that would call into question the GEIS's conclusions for subsequent license renewal of Turkey Point Units 3 and 4. Accordingly, and as concluded in the GEIS, the impacts of the Category 1 aquatic resource issues identified in Table 4-1 would be SMALL for the proposed Turkey Point subsequent license renewal. Table 4-2, "Applicable Category 2 (Site-Specific) Issues for the Turkey Point Site," in Section 4.1 of this SEIS identifies two aquatic resources site-specific (Category 2) issues applicable to Turkey Point during the subsequent license renewal term. These issues are analyzed below.

4.7.1.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

For plants with once-through cooling systems or cooling ponds such as Turkey Point, the NRC (NRC 2013a) has determined that impingement and entrainment of aquatic organisms is a Category 2 issue that requires site-specific evaluation. In 2002, the NRC staff evaluated the impacts of the Turkey Point initial license renewal on aquatic organisms as two issues: "impingement of fish and shellfish" and "entrainment of fish and shellfish in early life stages." For both issues, the NRC staff determined that impacts would be SMALL. In 2013, the NRC issued Revision 1 of the GEIS (NUREG-1437) (NRC 2013a), which combined these two issues into a single site-specific issue—"Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)." This section evaluates this consolidated issue as it applies to the proposed Turkey Point subsequent license renewal period.

Impingement is the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of water withdrawal (40 CFR 125.83, "What Special Definitions Apply to This Subpart?"). Impingement can kill organisms immediately or contribute to later mortality resulting from exhaustion, suffocation, injury, and other physical stresses. The potential for injury or death is generally related to the amount of time an organism is impinged, its susceptibility to injury, and the physical characteristics of the screen-washing system and fish return (if present) of the plant.

Entrainment is the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a cooling water system (40 CFR 125.83). Organisms susceptible to entrainment are generally of smaller size than those susceptible to impingement and include ichthyoplankton (fish eggs and larvae), larval stages of shellfish and other macroinvertebrates, zooplankton, and phytoplankton. Entrained organisms may experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals, any of which may result in injury or death (Mayhew et al. 2000).

A particular species can be subject to both impingement and entrainment if several life stages occur near a plant's intake. For instance, adults may be impinged against the screens, while larvae and eggs may be entrained. Depending on the size of the intake screen openings, juveniles can be susceptible to both impingement and entrainment: larger juveniles may be impinged, while smaller juveniles may be entrained. The magnitude of impacts on the aquatic environment resulting from impingement and entrainment depends on plant-specific characteristics of the cooling system (e.g., location of the plant intake, intake velocities, withdrawal volumes, screen technologies, and presence or absence of a fish return system) as well as characteristics of the aquatic resources (e.g., species present in the region, population distributions, species status, management objectives, and life history characteristics).

Below, the NRC staff analyzes impingement and entrainment during the proposed Turkey Point subsequent license renewal term in two parts. First, the staff considers impacts that would be experienced by the aquatic biota in the CCS, and second, the staff considers biota in adjacent natural aquatic environments, including Biscayne Bay and Card Sound.

Aquatic Organisms of the CCS

Aquatic organisms inhabiting the CCS may be impinged or entrained when water is drawn from the CCS into the Turkey Point intake structure. Water from the CCS flows from the canal system into eight intake channels and through 9.5-mm (0.37-inch) mesh intake screens at a rate of 4.48 feet per second (fps) (1.4 meters per second (m/s)). The maximum flow per intake channel is 225,375 gpm (14.2 m^3/s). Debris, including fish and other aquatic organisms, that become impinged on the screens are washed off and disposed of by FPL personnel. The Turkey Point intake structure does not contain a fish return system (FPL 2018g).

FPL has not conducted any impingement or entrainment studies within the CCS. The Federal Water Pollution Control Act (i.e., the Clean Water Act of 1972, as amended (CWA)) (33 U.S.C. 1251 et seq.) does not impose ecological study requirements because the State classifies the CCS as an industrial wastewater facility and because the CCS does not directly withdraw from or discharge into any natural surface waters. Due to the lack of impingement and entrainment data, the NRC staff evaluates the effects of this potential effect on CCS aquatic organisms qualitatively in this section. First, the NRC staff considers the baseline condition of the resource (i.e., the species that would be present and susceptible to impingement and entrainment during the proposed subsequent license renewal). The staff then considers whether the life history characteristics of these species combined with the engineering parameters of the Turkey Point intake structure would make impingement or entrainment likely. The staff then makes an overall conclusion for impingement and entrainment on aquatic organisms of the CCS.

Baseline Condition of the Resource

Section 3.7.3, "Aquatic Resources on the Turkey Point Site," of this SEIS describes the aquatic resources on the Turkey Point site and summarizes the results of past ecological surveys of the CCS. In this section, the NRC staff discusses the facts that a number of fish species reported from the CCS in 2007 and 2009 ecological surveys were not collected in the most recent 2016 ecological survey, submerged aquatic vegetation is no longer present in the system, and species diversity has generally declined over time. The surface water quality factors that have contributed to this ecological shift are described in Section 3.5.1, "Surface Water Resources." No surface water connections between the CCS and any natural waterbodies exist that would allow additional species to enter the CCS during the course of the proposed subsequent license renewal term. Thus, the NRC staff assumes that the baseline condition of the resource is the aquatic community as it occurs in the CCS today. The current community is of low diversity and includes only those species that can withstand hot, hypersaline waters with low dissolved oxygen and poor water clarity. In 2016, Ecological Associates, Inc. (EAI 2017) collected only the following four species from the CCS:

- sheepshead minnow (*Cyprinodon variegatus*)
- sailfin molly (Poecilia latipinna)
- eastern mosquitofish (*Gambusia holbrooki*)
- mudflat fiddler crabs (*Uca rapax*)

Although other species may continue to occur in the CCS in small numbers that were not captured during the 2016 study, the NRC staff considers the species listed above to be representative of the current CCS aquatic community. For the purposes of this analysis, the staff assumes that these species are also representative of the aquatic community that would be present in the CCS and susceptible to impingement and entrainment during the proposed subsequent license renewal term of 2032 through 2052 (Unit 3) and 2033 through 2053 (Unit 4). Below, the staff considers the vulnerability of these species to impingement or entrainment to determine the overall impact of impingement and entrainment on CCS aquatic organisms.

Impingement

To assess the risk of impingement on CCS organisms, the NRC staff compared documented swim speeds of representative CCS species to the water velocity at the Turkey Point intake structure. In scientific literature, fish swimming speeds are characterized as burst, prolonged, or sustained. Burst speeds are the highest speeds a fish can attain over very short periods of time (typically less than 20 seconds). Burst speeds are exhibited when an individual is capturing prey, avoiding a predator, or negotiating high water velocities, such as those associated with riffles and eddies in a fast-flowing river or the draw of a power plant's intake. Sustained speeds are low speeds fish can maintain indefinitely without fatigue. These speeds are observed during routine activities, including foraging, holding, and schooling. Prolonged (or critical) speeds are those of intermediate endurance that a fish could endure for approximately 20 to 30 minutes before ending in fatigue. If a species' reported swimming ability indicates that individuals can typically swim faster than a power plant's intake velocity, the species would exhibit a low likelihood of being impinged. Certain species may not be capable of maintaining a sustained speed that would allow escape from an intake velocity, but an individual could swim in a burst to avoid impingement. Swim speeds are typically measured in centimeters per second (cm/s). Thus, the NRC staff assumes that species with a documented burst speed less than 140 cm/s (1.4 m/s; 4.48 fps), which is the velocity of the Turkey Point intake, would be susceptible to impingement, and a species with a documented burst speed equal to or greater than this velocity would generally not be susceptible to impingement.

Sheepshead minnow belong to the family Cyprinodontidae. In laboratory tests, Leavy and Bonner (Leavy and Bonner 2009) determined the burst swimming speed of two species in this family of fish, plains killifish (*Fundulus zebrinus*) and blackstripe topminnow (*F. notatus*), to be 30.7 to 43.4 cm/s (0.307 to 0.434 m/s; 1.01 to 1.42 fps). Species-specific data is not available for sheepshead minnow. Therefore, for comparison, the NRC staff assumes that this range is comparable to the burst swim speed of sheepshead minnow. Based on this assumption, sheepshead minnow are susceptible to impingement at Turkey Point and any individuals within the area influenced by the Turkey Point intake velocity are likely to become impinged.

Sailfin molly and eastern mosquitofish both belong to the family Poeciliidae. In laboratory tests, Leavy and Bonner (Leavy and Bonner 2009) determined the burst swimming speed of two Poeciliidae species—sailfin molly and largespring gambusia (*Gambusia geiseri*)—to be 15.7 to 18.6 cm/s (0.157 to 0.186 m/s; 0.52 to 0.61 fps). In another test, Srean et al. (Srean et al. 2016) determined the critical swim speed of adult eastern mosquitofish to be 14.11 cm/s (0.1411 m/s; 0.46 fps). Based on this information, both sailfin molly and eastern mosquitofish are susceptible to impingement at Turkey Point.

Juvenile and adult mudflat fiddler crabs inhabit the intertidal zones of muddy areas of salt marshes and mangroves. Therefore, they would not generally occur in the open water of the CCS where they would be susceptible to impingement. Thus, mudflat fiddler crabs are likely not impinged or only rarely impinged by the Turkey Point intake structure.

Based on the available biometric information presented above, the NRC staff assumes that all fish in the CCS are susceptible to impingement. Because the Turkey Point intake structure does not have a fish return system, and FPL has no plans to alter the design or function of the Turkey Point cooling system under the proposed action, all impingement would result in mortality. However, most fish in the CCS are not at risk of impingement due to the layout of the system and the large size of the CCS relative to the small area influenced by the Turkey Point intake structure's withdrawal of water. Only those individuals in the CCS intake canal, specifically, would be at risk of impingement and only those individuals within the smaller area influenced by the intake velocity are likely to be impinged. Many fish in the CCS likely spend their lives in the main canals and are never exposed to impingement risk. In contrast, for a power plant whose intake draws from a river, migration or movement of fish past the plant would likely necessitate passage through the zone of the power plant intake's influence. For the reasons discussed above, the NRC staff concludes that while impingement at Turkey Point is likely to affect CCS aquatic populations, only a small portion of aquatic organisms would be susceptible to impingement at any given time.

Entrainment

A species' susceptibility to entrainment is closely related to the life history characteristics of early life stages. Species that lay adhesive eggs that sink to the bottom of the water column are less likely to be entrained than species that lay demersal eggs that float within the water column. Sheepshead minnow eggs are adhesive; these eggs stick to plants and bottom substrate and are, therefore unlikely to be entrained. Sailfin molly and eastern mosquitofish give birth to live young rather than laying a clutch of eggs. Newly born young of these species are, therefore, at risk of entrainment if young occur in the CCS intake canal and within the area influenced by the Turkey Point intake structure. Female mudflat fiddler crabs release eggs into the water column where they hatch into microscopic free-swimming larvae that then go through several molt stages. During this process, zoea would be susceptible to entrainment if they occur in water drawn into the Turkey Point intake structure. As with impingement, the NRC staff assumes that even for those species and life stages for which entrainment is possible, only a small portion of susceptible individuals occur in the CCS intake canal and, thus, entrainment risk is relatively low.

Impingement and Entrainment Conclusion for Cooling Canal System Aquatic Organisms

All fish inhabiting the CCS are likely susceptible to impingement, and early life stages of some species are also susceptible to entrainment. The large size of the CCS relative to the small area influenced by intake velocity of the Turkey Point intake structure mitigates the overall risk of impingement and entrainment. In the absence of specific studies, the extent to which impingement or entrainment may result in detectable or noticeable effects on the aquatic populations of the CCS is unknown. However, impingement and entrainment are unlikely to create effects great enough to destabilize important attributes of the aquatic environment over the course of the proposed subsequent license renewal term because the CCS aquatic community is composed of common species that exhibit no unique ecological value or niche and have no commercial or recreational value. The NRC staff, therefore, finds that impingement and entrainment during the proposed subsequent license renewal term would be of SMALL to MODERATE significance on the aquatic organisms of the CCS.

Aquatic Organisms of Biscayne Bay

Aquatic organisms inhabiting Biscayne Bay are not subject to impingement or entrainment because there are no surface water connections that allow flow between the waters of the Biscayne Bay and the CCS. Thus, aquatic organisms in Biscayne Bay and connected waterbodies (e.g., Card Sound, the Atlantic Ocean) never interact with the Turkey Point intake structure. Accordingly, the NRC staff concludes that the issue of impingement and entrainment during the proposed subsequent license renewal term does not apply to aquatic organisms in Biscayne Bay.

4.7.1.2 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

For plants with once-through cooling systems or cooling ponds such as Turkey Point, the NRC staff (NRC 2013a) has determined that thermal impacts on aquatic organisms is a Category 2 issue that requires site-specific evaluation. In 2002, the NRC staff evaluated the impacts of the Turkey Point initial license renewal on aquatic organisms as “heat shock,” and the NRC determined that impacts would be SMALL. In 2013, the NRC issued Revision 1 of the GEIS (NUREG-1437) (NRC 2013a), which renamed this issue as “Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds).” This section evaluates this issue for the proposed Turkey Point subsequent license renewal period.

The primary form of thermal impacts that would be of concern at Turkey Point is heat shock, which the NRC staff (NRC 2013a) defines as occurring when the water temperature meets or exceeds the thermal tolerance of a species for some duration of exposure. In most situations, fish are capable of moving out of an area that exceeds their thermal tolerance limits, although some aquatic species lack such mobility. Heat shock is typically observable only for fish, particularly those species that float when dead.

Aquatic Organisms of the CCS

Heated water discharged from Turkey Point moves from the discharge canal on the north end of the CCS, through 32 feeder canals, and south into a single collector canal that distributes water to 7 return canals. Water in the return canals flows north to the Turkey Point intakes. Excess heat is naturally dissipated through evaporation and groundwater exchange as water flows through the system. Thus, fish and other aquatic organisms experience the highest temperatures at the north end of the CCS within the discharge canal with gradually decreasing temperatures as water flows south through the system.

FPL has not conducted any thermal impact studies within the CCS. The Clean Water Act does not impose ecological study requirements on the CCS because the State of Florida classifies the CCS as an industrial wastewater facility and also because the CCS does not directly withdraw from or discharge into any natural surface waters. In the absence of thermal studies, the NRC staff evaluates the potential effects of thermal discharges on CCS aquatic organisms by comparing CCS discharge temperature data with the thermal tolerances of the species present in the CCS.

Baseline Condition of the Resource

As explained in the NRC staff's impingement and entrainment analysis in Section 4.7.1.1 of this SEIS, the staff assumes that the baseline condition of the resource for the proposed action is the aquatic community as it occurs in the CCS today. The current community is of low diversity and includes only those species that can withstand hot, hypersaline waters with low dissolved oxygen and poor water clarity. Only four species—sheepshead minnow, sailfin molly, eastern mosquitofish, and mudflat fiddler crab—were collected during the last ecological survey of the CCS in 2016 (EAI 2017). For the purposes of this analysis, the staff assumes that these species are also representative of the aquatic community that would be present in the CCS and susceptible to thermal stress during the proposed subsequent license renewal term.

Previous to the 2016 survey, a number of fish, mollusks, crabs, and submerged aquatic vegetation were observed or recorded as occurring in the CCS (described in Section 3.7.3, "Aquatic Resources on the Turkey Point Site," of this SEIS). 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 system at the time of the 2016 survey, and EAI (EAI 2017) stated in its report that temperature-related stress was one of the factors that contributed to the die-off of the CCS's 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 also to the decline of fish and other aquatic biota and the observed shift towards more heat-tolerant species in recent years. The staff addresses these impacts in the cumulative impact analysis in Section 4.16.4, "Aquatic Resources," because they are past impacts associated with the current renewed license term. The analysis below focuses on future impacts that would be associated with the proposed subsequent license renewal term of 2032 through 2052 (Unit 3) and 2033 through 2053 (Unit 4).

Cooling Canal System Discharge Temperature Data

For each calendar month, FPL reports the highest average daily temperature of the cooling water discharge at Outfall 001 to the Florida Department of Environmental Protection as a requirement of the Turkey Point industrial wastewater facility NPDES Permit No. FL0001562. Table 4-3 below presents these daily maximum temperatures for the past 5 full calendar years (2012–2017). As is typical for the region, the highest temperatures occur in July, and the lowest temperatures occur in January. However, CCS discharge temperatures remain relatively high year-round and are often above the thermal tolerances of many fish (often around 95 °F (35 °C)). FPL (2018g) reports that water temperatures drop approximately 13.7 °F (7.6 °C) over the course of flow from the discharge point to the south end of the CCS. Thus, the minimum temperature likely ranged from roughly 69.9 to 97.9 °F (21.1 to 36.6 °C) with some thermal stratification occurring such that deeper areas of the canal system would have experienced slightly lower temperatures than those measured at the surface.

Table 4-3 Average Maximum Daily Temperature at CCS Outfall 001

	Temperature (°F) [a]					
Month	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
January	97.3	90.6	89.9	89.1	95.7	91.0
February	94.7	68.8	106.5	100.3	94.1	98.6
March	94.7	83.6	101.1	105.0	103.2	95.4
April	91.2	93.6	106.7	109.0	90.1	94.8
May	97.1	97.6	103.2	102.7	104.6	103.4
June	90.0	109.2	107.9	112.2	109.7	104.6
July	100.2	111.6	108.2	107.2	111.5	108.3
August	89.8	106.6	106.6	110.4	110.4	110.0
September	97.6	108.4	100.2	105.2	110.4	101.9
October	97.5	101.5	99.0	94.0	94.8	101.9
November	95.0	94.2	89.0	102.6	96.3	96.8
December	93.1	94.8	103.2	94.7	100.4	97.5

[a] To convert temperatures in degrees Fahrenheit to Celsius, subtract 32 and multiply by 5/9.

Source: FPL 2018g

Thermal Tolerances of Aquatic Species

Sheepshead minnow are part of the family Cyprinodontidae, which are known for their ability to survive extreme seasonal and diurnal shifts in water temperature. Sheepshead minnow, specifically, can be found in the harsh environments of subtropical south Texas's shallow tide pools at temperatures as high as 109.4 °F (43 °C) and when the combination of other abiotic conditions become so extreme that no other species can persist (Strawn and Dunn 1967; Harrington and Harrington 1961). In static and dynamic thermal tolerance tests of 800 sheepshead minnow collected from a shallow tidepool of the Brazos Santiago Pass in Texas, Bennet and Beitinger (Bennett and Beitinger 1997) found that the species has the largest physiological thermal tolerance range ever measured in a fish. In the tests, individuals acclimated to 69.8 °F (21.0 °C) and 100.4 °F (38.0 °C) were able to tolerate temperatures up to 104.18 °F (40.1 °C) and 111.56 °F (44.2 °C), respectively. Bennet and Beitinger (Bennett and Beitinger 1997) determined the species' critical thermal maxima—the temperature at which activity becomes disorganized and an organism loses its ability to escape conditions which will promptly lead to death—to be 113 °F (45.1 °C).

Both the sailfin molly and eastern mosquitofish are also rather heat-tolerant species. In critical thermal maxima tests, these species have been found capable of withstanding temperatures up to or slightly higher than 104 °F (40 °C) (Fischer and Schlupp 2009; Meffe et al. 1995). Mudflat fiddler crabs have been documented as tolerating waters of temperatures up to 111.4 °F (44 °C) (Smithsonian 2009). The mobility of this species also allows individuals to leave waters that are too hot and seek refuge elsewhere.

Thermal Impacts Discussion

The aquatic community of the CCS is composed of species that can survive in extreme temperatures. CCS temperature data indicate that water in the system remains below the thermal tolerances of the aquatic species present during the majority of the year. During the summer months, waters at and near the cooling water discharge at CCS Outfall 001 may approach or exceed the thermal tolerances of aquatic species. However, the CCS is a large system, and the area over which water temperatures would be uninhabitable would be relatively small. Thus, fish and other mobile aquatic organisms could seek refuge in cooler areas. Additionally, the State has required FPL to implement a thermal efficiency plan (described in detail in Section 3.5.1) as a condition of the 2016 Consent Order to control CCS salinity and temperature (FDEP 2016e). FPL has begun implementing this plan, and FPL's continued execution of the plan will ensure that CCS temperatures are moderated over the course of the proposed subsequent license renewal term. The combination of these factors (i.e., the heat-tolerant aquatic community present in the CCS, the small area of the CCS over which water temperatures typically exceed species' critical thermal maxima, and the State-mandated requirements for FPL to control CCS temperatures and salinity) make the likelihood of mortality of aquatic organisms from Turkey Point's thermal effluent during the subsequent license renewal term relatively low. Nevertheless, the high-temperature environment of the CCS is likely to exert physiological stress on aquatic organisms that could have fitness consequences, including reproductive effects, increased susceptibility to disease or infection, and reduced ability to escape predators. While these effects may be noticeable, they are unlikely to destabilize important attributes of the aquatic environment over the course of the proposed subsequent license renewal term.

Thermal Impact Conclusion for CCS Aquatic Organisms

The aquatic community that currently inhabits the CCS can withstand high temperatures and continued thermal discharges from Turkey Point over the course of the proposed subsequent license renewal period are unlikely to further alter the composition of the community. Thermal impacts may result in some degree of physiological stress on CCS aquatic organisms. In the absence of specific studies, the extent to which such stresses may result in detectable or noticeable effects is unknown. However, thermal impacts are unlikely to create effects great enough to destabilize important attributes of the aquatic environment over the course of the proposed subsequent license renewal term because the CCS aquatic community is composed of species that exhibit no unique ecological value or niche and have no commercial or recreational value. The NRC staff, therefore, finds that thermal impacts during the proposed subsequent license renewal term would be of SMALL to MODERATE significance on the aquatic organisms of the CCS.

<u>Aquatic Organisms of Biscayne Bay</u>

Aquatic organisms inhabiting Biscayne Bay are not subject to thermal impacts associated with Turkey Point because there are no surface water connections that allow flow between these waters and the CCS. Thus, aquatic organisms in this water body and connected waterbodies (e.g., Card Sound, the Atlantic Ocean, etc.) do not interact with Turkey Point's thermal discharge. Accordingly, the NRC staff concludes that the issue of thermal impacts during the proposed subsequent license renewal term does not apply to aquatic organisms in Biscayne Bay.

4.7.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point Units 3 and 4 would shut down on or before the expiration of the current renewed licenses. The CCS would continue to operate to support retired fossil fuel Units 1 and 2 in synchronous condenser mode. If Turkey Point Units 3 and 4 were to cease operating, impacts to CCS aquatic resources would decrease or stop following reactor shutdown. The amount of CCS water withdrawn for cooling purposes would decrease significantly following shutdown, although some withdrawal would continue during the shutdown period as the remaining fuel cools. The reduced demand for cooling water would substantially decrease the effects of impingement, entrainment, thermal effluents, and other impacts to aquatic biota in the CCS. Withdrawals would eventually cease, which would eliminate these impacts.

The CCS would continue to operate under the no-action alternative because it supports retired fossil fuel Units 1 and 2. FPL plans to continue to withdraw water from the CCS to support these units' operation in synchronous condenser mode over the course of the proposed subsequent license renewal period, as described in Section 3.1.3, "Cooling and Auxiliary Water Systems." Additionally, Unit 5, which remains in operation, discharges blowdown to the CCS. CCS conditions could change under the no-action alternative because less heat would be discharged to the system, which would potentially make conditions less saline and more favorable to aquatic life. However, flow would likely decrease following shutdown because Turkey Point Units 3 and 4 would not require as much water. Less flow could lead to stagnant conditions and lower habitat quality. However, the CCS would continue to provide habitat for the existing aquatic community. Additionally, FPL would continue CCS restoration activities, as described in Section 3.7, "Aquatic Resources." The State of Florida requires these activities under FPL's Nutrient Management Plan which is independent of subsequent license renewal. Restoration activities would likely eventually return portions of the CCS to a seagrass-based ecological system.

The no-action alternative would not affect aquatic resources in Biscayne Bay, Card Sound, or the Atlantic Ocean because there are no surface water connections that allow flow between these waters and the waters of the CCS; therefore, aquatic organisms in these waterbodies do not interact with the Turkey Point intake structure and are not subject to impingement, entrainment, thermal discharges, or any other effects.

The NRC staff concludes that the impacts of the no-action alternative on aquatic resources would be SMALL.

4.7.3 Replacement Power Alternatives: Common Impacts

Each replacement power alternative would entail construction and operation of a new energy generating facility on the existing 9,500-ac (3,800-ha) Turkey Point site but outside the footprint of Turkey Point Units 3 and 4 and outside the footprint of the proposed Turkey Point Units 6 and 7. Each replacement plant would use mechanical draft cooling towers that would draw water from reclaimed wastewater at varying rates depending on each alternative's cooling requirements. Both alternatives involving a new natural gas plant would require a pipeline to connect the new facility to an existing natural gas supply line located approximately 100 mi (160 km) north of the Turkey Point site.

For all alternatives discussed in this section, the impacts of construction on aquatic resources would be qualitatively similar. During construction, the use of the existing Turkey Point site would allow FPL to use some existing buildings and infrastructure. However, an additional 75 to 540 ac (30 to 220 ha) of undeveloped land on or near the site would be required depending on the specific alternative. The solar component of the combination alternative may require up to 1,400 ac (570 ha) of additional offsite land, and rights-of-way and gas extraction may require additional land, as well. Given the prevalence of wetlands, mangrove forests, mudflats, and other aquatic features on and near the Turkey Point site, it is unlikely that FPL would be able to completely avoid destroying or degrading these habitats during construction of buildings, cooling towers, and other plant components associated with any of the replacement power alternatives. Thus, construction would likely result in permanent loss of some onsite aquatic habitats. The resulting habitat fragmentation could affect ecosystem function and connectivity of aquatic habitats. Habitat degradation associated with runoff, erosion, and sedimentation during construction could also occur. Additionally, direct mortality of aquatic organisms could result from dredging, wetland and mangrove filling, and other necessary in-water work. Barge traffic associated with delivery of construction supplies and plant components to the site would release pollutants into aquatic habitats and could result in collision-related injury or mortality of larger aquatic organisms, especially turtles and marine mammals.

Appropriate permits would mitigate some water quality and aquatic resource impacts by requiring FPL to implement best management practices or other mitigation measures during construction and/or operation. The U.S. Army Corps of Engineers or the Florida Department of Environmental Protection would oversee applicable Clean Water Act permitting, including Section 404 permits for dredging and fill activities, Section 401 certification, and Section 402(p) National Pollutant Discharge Elimination System (NPDES) general stormwater permitting. While adherence to these permits would minimize effects on aquatic resources, the prevalence of sensitive aquatic habitats on the Turkey Point site would make some level of impact unavoidable. Construction of any of the replacement power alternatives could affect wetland or mangrove connectivity and could degrade or reduce the value of these habitats as nurseries for fish and shellfish. Such effects would likely be noticeable and could destabilize these attributes of the aquatic environment depending on the particular alternative selected and the siting of the plant.

During operation of any of the replacement power alternatives, the potential impacts on aquatic resources would be qualitatively similar to those that would be experienced as a result of the proposed action of subsequent license renewal. Once built, operation of a replacement power plant would have minimal to no discernable impacts on aquatic resources given that a new power plant would use reclaimed wastewater for cooling. Thus, impingement, entrainment, thermal effects, and water use conflicts would not be an issue.

4.7.4 New Nuclear Alternative

The NRC staff did not identify any impacts to aquatic resources for the new nuclear alternative beyond those discussed in the impacts common to all replacement power alternatives. However, the common impact would be more intense for the new nuclear alternative compared to the other alternatives because of the larger land area requirement, which would result in more habitat loss and the potential for higher rates of erosion and sedimentation into aquatic habitats. Impacts of this alternative would be MODERATE to LARGE in the local environs of the plant due to the sensitive nature of the wetlands, mangrove forests, mudflats, and other nearby aquatic habitats and the likelihood that construction would convert (destroy) or degrade these habitats. The permanent loss or alteration of these aquatic habitats would likely result in habitat fragmentation that could affect ecosystem function and connectivity of aquatic habitats. The exact level of impact would depend on whether the chosen site results in the permanent loss, impairment, fragmentation, or reduced ecosystem function of affected aquatic habitats.

4.7.5 Natural Gas Combined-Cycle Alternative

The common impacts described above would be less intense for the natural gas alternative compared to the new nuclear alternative. Because the natural gas alternative would disturb less land, it would, therefore, have less likelihood of impairing aquatic habitat connectivity or function. In addition to the common impacts, the natural gas alternative would require construction of a gas pipeline, which could result in erosion, sedimentation, or disturbance of aquatic habitats during the construction phase. The exact degree of impacts would depend on the amount and quality of aquatic habitat along the chosen pipeline route and the implementation of best management practices during construction. During operation, the natural gas alternative would emit pollutants that could degrade aquatic habitats. The NRC staff concludes that impacts of a natural gas alternative on aquatic resources would be MODERATE to LARGE in the local environs of the plant, due to the permanent loss of aquatic habitats during plant siting and the potential for additional disturbance or loss of aquatic habitats during pipeline construction. The exact level of impact would depend on whether the chosen plant site and pipeline route results in the permanent loss, impairment, fragmentation, or reduced ecosystem function of affected aquatic habitats.

4.7.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

The NRC staff did not identify any impacts to aquatic resources for the natural gas portion of the combination alternative beyond those already discussed above for the natural gas-only alternative. For the solar portion of the combination alternative, the exact level of disturbance or degradation that aquatic habitats would experience would depend on the specific siting of solar panels and infrastructure. Given the large area of land that the solar component would require (approximately 1,400 ac (570 ha) for three offsite solar units, in total) and the prevalence of wetlands, mangrove forests, and other important aquatic habitats within the region where the solar units would be sited, construction would likely result in permanent loss or impairment of aquatic habitats. The NRC staff concludes that impacts of a combination alternative on aquatic resources would be MODERATE to LARGE in the local environs of the plant, due to the permanent loss of aquatic habitats during natural gas plant and solar panel siting. The exact level of impact would depend on whether the chosen natural gas plant site and solar panel sites result in the permanent loss, impairment, fragmentation, or reduced ecosystem function of affected aquatic habitats.

4.7.7 Cooling Water System Alternative

The NRC staff did not identify any impacts to aquatic resources for the cooling water system alternative beyond those discussed in the impacts common to all replacement power alternatives. Although Turkey Point would no longer use the CCS for cooling under this alternative, the CCS itself would continue to operate because it supports Units 1 and 2. FPL plans to continue to withdraw water from the CCS to support the operation of Units 1 and 2 in synchronous condenser mode throughout the proposed period of subsequent license renewal, as described in Section 3.1.3, “Cooling and Auxiliary Water Systems.” FPL would continue CCS restoration activities, as described in Section 3.7, “Aquatic Resources,” under this alternative. The State of Florida requires these activities under FPL’s Nutrient Management Plan which is independent of subsequent license renewal. Restoration activities would likely return portions of the CCS to a seagrass-based ecological system. Construction of cooling towers on the Turkey Point site would result in the permanent loss or impairment of sensitive aquatic habitats and could affect ecosystem function and connectivity. Therefore, the NRC staff concludes that the impacts of implementing the cooling water system alternative on aquatic resources would be MODERATE in the local environs of the plant.

4.8 Special Status Species and Habitats

This section describes the potential special status species and habitats impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.8.1 Proposed Action

Table 4-2 identifies the one Turkey Point site-specific (Category 2) issue related to special status species and habitats applicable to the area during the subsequent license renewal term. This issue is analyzed below.

4.8.1.1 Species and Habitats Protected Under the Endangered Species Act

Species and Habitats under U.S. Fish and Wildlife Service Jurisdiction

Section 3.8, "Special Status Species and Habitats," in this SEIS describes 42 federally listed species solely under U.S. Fish and Wildlife Service's (FWS) jurisdiction that occur in the action area. In that section, the NRC staff concludes that 25 of these species would not occur in the action area because those species are extirpated from Miami-Dade County, are not known to occur within Miami-Dade County, or no suitable habitat occurs within the action area. An additional four species are under the shared jurisdiction of the FWS and the National Marine Fisheries Service. The NRC staff has determined that continued operation of Turkey Point Units 3 and 4 would have no effect on any portions of these species' life cycles that are under FWS's jurisdiction (NRC 2018g). In addition, two species are listed because of similarity of appearance to other listed species and, therefore, are not subject to the Endangered Species Act, Section 7 consultation requirement.

The NRC staff analyzes the potential impacts of the proposed Turkey Point subsequent license renewal on the remaining 15 species and on the designated critical habitat of two of these species within its biological assessment (NRC 2018n). The NRC staff incorporates by reference the biological assessment (NRC 2018n) into this SEIS. The NRC staff's Endangered Species Act effect determination for each species is summarized below in Table 4-4.

Table 4-4 Effect Determinations for Federally Listed Species Under U.S. Fish and Wildlife Service Jurisdiction

Species	Common Name	Status[a]	Impact[b]
	Mammals		
Eumops floridanus	Florida bonneted bat	FE	may affect, but is not likely to adversely affect
Puma concolor coryi	Florida panther	FE	may affect, but is not likely to adversely affect
Puma concolor (all sub species except *coryi*)	puma	SAT	-

Species	Common Name	Status[(a)]	Impact[(b)]
Trichechus manatus	West Indian manatee	FT	may affect, but is not likely to adversely affect; no adverse modification to designated critical habitat
		Birds	
Ammodramus maritimus mirabilis	Cape Sable seaside sparrow	FE	no effect
Ammodramus savannarum	Florida Grasshopper sparrow	FE	no effect
Aphelocoma coerulescens	Florida scrub-jay	FT	no effect
Caladris rufa	red knot	FT	may affect, but is not likely to adversely affect
Campephilus principalis	ivory-billed woodpecker	FE	no effect
Charadrius melodus	piping plover	FT	may affect, but is not likely to adversely affect
Mycteria americana	wood stork	FT	may affect, but is not likely to adversely affect
Picoides borealis	red-cockaded woodpecker	FE	no effect
Rostrhamus sociabilis	Everglades snail kite	FE	may affect, but is not likely to adversely affect
Setophaga kirtlandi	Kirtland's warbler	FE	may affect, but is not likely to adversely affect
Vermivora bachmani	Bachman's warbler	FE	no effect
		Reptiles	
Alligator mississippiensis	American alligator	SAT	-
Crocodylus acutus	American crocodile	FT	likely to adversely affect; adverse modification to designated critical habitat
Drymarchon corais couperi	eastern indigo snake	FT	likely to adversely affect
		Invertebrates	
Anaea troglodyta floridalis	Florida leafwing butterfly	FE	no effect
Cyclargus (=Hemiargus) thomasi bethunebakeri	Miami blue butterfly	FE	no effect
Heraclides aristodemus ponceanus	Schaus swallowtail butterfly	FE	no effect
Orthalicus reses	Stock Island Tree Snail	FT	no effect
Strymon acis bartrami	Bartram's hairstreak butterfly	FE	no effect
		Flowering Plants	
Amorpha crenulata	crenulate lead-plant	FE	no effect

Species	Common Name	Status(a)	Impact(b)
Argythamnia blodgettii	Blodgett's silverbush	FT	may affect, but is not likely to adversely affect
Brickellia mosieri	Florida brickell-bush	FE	no effect
Chamaesyce deltoidea ssp. deltoidea	deltoid spurge	FE	no effect
Chamaesyce deltoidea pinetorum	pineland sandmat	FT	no effect
Chamaesyce garberi	Garber's spurge	FT	no effect
Chromolaena frustrata	Cape Sable thoroughwort	FE	may affect, but is not likely to adversely affect
Consolea corallicola	Florida semaphore cactus	FE	may affect, but is not likely to adversely affect
Cucurbita okeechobeensis ssp. okeechobeensis	Okeechobee Gourd	FE	no effect
Dalea carthagenensis floridana	Florida prairie-clover	FE	no effect
Digitaria pauciflora	Florida pineland crabgrass	FT	no effect
Galactia smallii	Small's milkpea	FE	no effect
Jacquemontia reclinata	beach jacquemontia	FE	no effect
Linum arenicola	sand flax	FE	may affect, but is not likely to adversely affect
Linum carteri carteri	Carter's small-flowered flax	FE	no effect
Polygala smallii	tiny polygala	FE	no effect
Sideroxylon reclinatum ssp. austrofloridense	Everglades bully	FT	no effect
Warea carteri	Carter's mustard	FE	no effect
	Ferns		
Trichomanes punctatum ssp. *floridanum*	Florida bristle fern	FE	may affect, but is not likely to adversely affect

(a) SAT = Federally listed due to similarity of appearance to another listed species, FE = Federally listed as endangered, FT = Federally listed as threatened at 50 CFR Part 17, “Endangered and Threatened Wildlife and Plants,” under the provisions of the Endangered Species Act

Species and Habitats under National Marine Fisheries Service Jurisdiction

Section 3.8, “Special Status Species and Habitats,” describes five federally listed species under the National Marine Fisheries Service’s (NMFS) jurisdiction that occur in the action area: loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and smalltooth sawfish (*Pristis pectinata*). In that section, the NRC staff concludes that all of these species occur in the action area within Biscayne Bay but that none occur on the Turkey Point site itself, including within the CCS. The NRC staff analyzes the potential impacts of the proposed Turkey

Point subsequent license renewal on these five species below. Table 4-5, below, summarizes the NRC staff's Endangered Species Act effect determination for each species.

Table 4-5 Effect Determinations for Federally Listed Species Under National Marine Fisheries Service Jurisdiction

Species	Common Name	Federal Status[(a)]	Effect Determination
	Sea Turtles		
Caretta caretta	loggerhead	FT	may affect, but is not likely to adversely affect
Chelonia mydas	green	FT[(b)]	may affect, but is not likely to adversely affect
Dermochelys coriacea	leatherback	FE	may affect, but is not likely to adversely affect
Eretmochelys imbricata	hawksbill	FE	may affect, but is not likely to adversely affect
	Fish		
Pristis pectinata	smalltooth sawfish	FE[(b)]	may affect, but is not likely to adversely affect

[(a)] FE = Federally listed as endangered and FT = Federally listed as threatened at 50 CFR Part 17, "Endangered and Threatened Wildlife and Plants," under the provisions of the Endangered Species Act.

[(b)] The identified Federal status applies to the following distinct population segment(s) (DPS): Northwest Atlantic and South Atlantic DPSs of the green turtle and United States DPS of the smalltooth sawfish.

Impingement, Entrainment, and Thermal Effects

In the GEIS (NUREG-1437) (NRC 2013a), the NRC staff identified a number of issues (or impacts) that the aquatic ecological environment could experience as a result of license renewal of a nuclear plant. These impacts, as they apply to the proposed Turkey Point subsequent license renewal, are identified in Table 4-1 and Table 4-2. As described in Section 4.7, "Aquatic Resources," because the CCS does not directly withdraw from or discharge to any other surface waters, the effects of impingement, entrainment, and thermal discharges are not applicable for aquatic biota in Biscayne Bay or any other natural waterbodies. Thus, federally listed sea turtles and smalltooth sawfish occurring in the action area would not be subject to these impacts.

Barge Traffic

Barge traffic associated with subsequent license renewal has the potential to impact sea turtles and smalltooth sawfish inhabiting Biscayne Bay. Continued operation of Turkey Point during the subsequent license renewal term would necessitate infrequent deliveries of large parts and equipment to the Turkey Point site. FPL (FPL 2018g) estimates that up to five barges in a single year at intervals of 4 to 5 years would travel to and from Turkey Point during the proposed subsequent license renewal term. This level of vessel traffic would include combined deliveries associated with Turkey Point Units 3 and 4; Turkey Point Units 1, 2, and 5; and the onsite independent spent fuel storage installation (FPL 2018g).

Sea turtles and smalltooth sawfish in Biscayne Bay could be injured or killed during interactions with barge vessels as the vessels travel through the Bay. However, the infrequency of vessel traffic and the ability of sea turtles and smalltooth sawfish to move away from vessels to avoid impact make such effects extremely unlikely to occur. The NMFS assessed the impacts of barge traffic, among other effects, as part of its Endangered Species Act, Section 7 consultation with the NRC for the proposed construction of Turkey Point Units 6 and 7 in 2017. Construction of the two new units would involve regular barge deliveries as well as pile driving and basin dredging, all of which the NMFS (NMFS 2017a) found to be discountable. The NRC staff finds the same conclusion to be reasonable for the proposed Turkey Point Units 3 and 4 subsequent license renewal because this action would require much less frequent barge deliveries and would not involve any dredging or other in-water work. Additionally, the NRC staff is not aware of any sea turtle or smalltooth sawfish injuries or mortalities associated with Turkey Point barge traffic since the units began operating in 1972 (Unit 3) and 1974 (Unit 4). Compared to the original license and initial renewed license terms, barge traffic would continue at similar or less frequent rates during the proposed subsequent license renewal term. Accordingly, the NRC staff finds this potential impact to be discountable.

Biscayne Bay Water Quality

During the NEPA scoping period, the NRC staff received comments recommending that the staff consider the potential impacts of interactions between the CCS and nearby surface waterbodies on federally listed species. The commenters' suggestions stemmed primarily from the concern that contaminants in the CCS could affect water quality in the Bay, which would in turn affect federally listed species. The NRC staff evaluates this potential impact below.

In the GEIS (NUREG-1437), the NRC staff generically addressed for all nuclear power plants the potential for both radioactive and non-radiological contaminants associated with license renewal to affect aquatic biota (NRC 2013a). With regard to the potential for sea turtles and smalltooth sawfish to be exposed to radionuclides, the NRC staff (NRC 2013a) determined that exposure to radionuclides would be of SMALL significance for aquatic organisms during the license renewal term for all nuclear power plants because exposure would be well below U.S. Environmental Protection Agency guidelines developed to protect aquatic biota. The NRC staff also concluded in the GEIS that effects of non-radiological contaminants on aquatic organisms would be SMALL because best management practices and discharge limitations contained in applicable State-issued water quality permits would minimize the potential for adverse impacts. 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). Such an effect level would equate to "insignificant" in Endangered Species Act terminology (i.e., 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).

At Turkey Point specifically, the potential pathway for exposure of aquatic organisms in Biscayne Bay to water or contaminants from the CCS is indirect and complex. As described in Section 3.5.1, "Surface Water Hydrology," of this SEIS, the CCS is situated above the Biscayne aquifer. The porous nature of the limestone bedrock that forms the Biscayne aquifer results in some groundwater exchange between the CCS and the aquifer. This exchange of groundwater between the CCS and the Biscayne aquifer creates a pathway through which the CCS may influence Biscayne Bay. Groundwater under the Turkey Point site flows east (towards Biscayne Bay) or west (inland and away from the Bay) depending on the head levels in the aquifer relative to the water levels in Biscayne Bay. Within the larger regional context, South Florida's water is highly influenced by a complex system of crisscrossing canals that drain surface waters from the land for agricultural and urban use, provide flood control, and discharge freshwater into Biscayne Bay and Card Sound. The State manages the canal system as a coastal control structure to maintain relatively high water levels along the coast and prevent saltwater intrusion within near-surface groundwater aquifers. The State of Florida and Miami-Dade County have required FPL to take actions to abate hypersaline water discharges from the CCS and to actively remediate the hypersaline groundwater west and north of FPL's property. Many of FPL's current actions are specified in a June 2016 consent order issued by the Florida Department of Environmental Protection or in an October 2015 consent agreement issued by the Miami-Dade County Department of Environmental Resources Management (DERM) (see Section 3.5.2.2, "Groundwater Quality" for more detailed information). Both the consent order and agreement contain requirements that aim to ensure that the CCS does not adversely affect the region's surface waters. Thus, the water quality experienced by sea turtles and smalltooth sawfish inhabiting Biscayne Bay depends on many factors, including Biscayne Bay water conditions, groundwater head levels, freshwater inflow from precipitation, the State's management of South Florida's regional canal system, and FPL's implementation of State- and County-imposed requirements.

As part of the requirements of the State's consent order, 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 mangrove areas and quarterly in marsh areas. In FPL's 2017 report, which analyzes data collected during the reporting period of June 1, 2016, through May 31, 2017, FPL found no evidence of CCS water in the surrounding marsh and mangrove areas from a groundwater pathway, and 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 (E&E 2017). FPL's monitoring plan and associated results are described in more detail in Section 3.5.1, "Surface Water Hydrology" of this SEIS.

More recently, in July 2018, the Miami-Dade County Division of Environmental Resources Management (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 concentrations (MDC 2018a). 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 believed that the CCS may be one source contributing to the elevated ammonia levels, it 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 CCS.

Elevated ammonia levels are of concern in aquatic environments because when ammonia is present at high enough levels in the environment, 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 sea turtles, data on the effects of ammonia are not currently available. In the absence of species-specific information, the NRC assumes that the relevant State water quality criteria are reasonably protective of sea turtles because under Section 303(c) of the Clean Water Act, the EPA or the States are required to adopt water quality standards to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. For delegated States, the EPA 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 EPA's national recommended aquatic life criteria. Therefore, if waters inhabited by sea turtles meet State water quality criteria for ammonia, the NRC staff assumes that there would be no lethal effects or impairment to growth, survival, or reproduction to sea turtle individuals. As described above, the Miami-Dade County 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 where sea turtles are unlikely to be present rather than in Biscayne Bay itself were sea turtles are more likely to be present. Even if sea turtles were to be present in the canals, exposure time would be limited because sea turtles are expected to only occur transiently and for short durations, if at all. Additionally, as described above, 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 itself where sea turtles are more likely to be present. In summary, the very low likelihood of sea turtles to be exposed to elevated ammonia levels and the short duration of potential exposure is unlikely to result in measurable effects on sea turtles.

Toxicity data for smalltooth sawfish exposure to ammonia or for taxonomically related species that would serve as a reasonable surrogate are also unavailable. However, the NRC staff assumes that, as with sea turtles, the State water quality criteria are reasonably protective of smalltooth sawfish. Additionally, ureotelic species (species that excrete most of their waste nitrogen in the form of urea in the urine), such as the smalltooth sawfish, regulate the ion concentrations in their body fluids to maintain osmotic balance with their external environment, which reduces the influx of ammonia from the external environment (NMFS 2016a). Ureotelic species also convert ammonia to urea and native tri-methyl amine oxide, which counteracts its toxicity (NMFS 2016a). As such, smalltooth sawfish are expected to be less vulnerable to ambient ammonia than many other aquatic species. In a 2016 biological opinion on the EPA's approval of Florida water quality standards under Section 303(c) of the Clean Water Act, the National Marine Fisheries Service (NMFS 2016a) concluded that ammonia concentrations were not likely to adversely affect the survival or fitness of smalltooth sawfish individuals because responses to anticipated ammonia concentrations from the implementation of the revised standards would be insignificant based on what is known about nitrogen metabolism and ion regulation for ureotelic elasmobranch species like the smalltooth sawfish. Based on this information, the NRC staff finds that even if smalltooth sawfish are present in the canal areas with elevated ammonia levels, individuals are unlikely to be measurably affected.

In addition to the reasons set forth above, potential water quality effects on sea turtles and smalltooth sawfish would be limited because the NRC staff assumes that FPL will adhere to, and that the State and County will enforce, the various mitigation requirements such that ammonia and other nutrients and contaminants associated with the CCS will not discernably affect the aquatic ecology of Biscayne Bay over the course of the proposed subsequent license renewal term. Accordingly, water quality associated with the continued operation of Turkey Point would not result in effects on sea turtles or smalltooth sawfish that would be able to be meaningfully measured, detected, or evaluated. The NRC staff concludes that water quality effects from the continued operation of Turkey Point would result in insignificant impacts on these species.

Conclusion

In conclusion, potential impacts on federally listed species under the NMFS's jurisdiction associated with the proposed action could result from (1) interactions of sea turtles and smalltooth sawfish with barge vessels and (2) the potential for groundwater exchange with the CCS to result in water quality impacts in Biscayne Bay, which could in turn affect sea turtles or smalltooth sawfish. For the reasons set forth above, the NRC staff finds these potential impacts to be discountable or insignificant. Accordingly, the NRC staff concludes that the proposed subsequent license renewal of Turkey Point may affect, but is not likely to adversely affect, loggerhead, green, leatherback, and hawksbill sea turtles and smalltooth sawfish.

<u>Cumulative Effects</u>

The Endangered Species Act regulations at 50 CFR 402.12(f)(4) direct Federal agencies to consider cumulative effects as part of the proposed action effects analysis. Under the Endangered Species Act, cumulative effects are defined as "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, "Definitions"). Unlike the National Environmental Policy Act (NEPA) definition of cumulative impacts (see Section 4.16, "Cumulative Impacts"), cumulative effects under the Endangered Species Act do not include past actions or other Federal actions requiring separate Endangered Species Act, Section 7 consultation. When formulating biological opinions under formal Endangered Species Act Section 7 consultation, the FWS and the NMFS (1998) consider cumulative effects when determining the likelihood of jeopardy or adverse modification. Therefore, cumulative effects need only be considered under the Endangered Species Act if listed species will be adversely affected by the proposed action and formal Section 7 consultation is necessary (FWS 2014b). Because the NRC staff concluded earlier in this section that the proposed subsequent license renewal is not likely to adversely affect sea turtles or smalltooth sawfish, consideration of cumulative effects for these species is not necessary. For those species under the U.S. Fish and Wildlife Service's jurisdiction, cumulative impacts are discussed, as appropriate, in the staff's biological assessment (NRC 2018n).

4.8.1.2 Species and Habitats Protected Under the Magnuson–Stevens Act

Section 3.8, "Special Status Species and Habitat," describes seven federally managed species for which the South Atlantic Fishery Management Council and NMFS have designated Essential Fish Habitat (EFH) in Biscayne Bay: pink shrimp (*Farfantepenaeus duorarum*), white grunt (*Haemulon plumieri*), bluestriped grunt (*Haemulon sciurus*), mutton snapper (*Lutianus analis*), dog snapper (*Lutianus jocu*), gray snapper (*Lutjanus griseus*), and spiny lobster (*Panulirus argus*). In that section, the NRC staff concludes that while EFH occurs in Biscayne Bay, neither EFH nor the species themselves occur on the Turkey Point site.

The proposed Turkey Point subsequent license renewal would not result in any impacts to EFH. As described above in Section 4.8.1.1, "Species and Habitats Protected Under the Endangered Species Act," the only potential activity that would affect aquatic resources outside of the Turkey Point site is vessel traffic associated with infrequent deliveries of large parts and equipment to the Turkey Point site and specifically associated with Units 3 and 4. However, such traffic would not impact any aquatic habitats (including prey) in any noticeable or measurable way and, thus, would also not affect EFH. The NRC staff also does not expect that federally managed species themselves or their prey would be directly affected by barge traffic because individuals could swim away to avoid vessels. Additionally, several of the federally managed species or their prey are bottom-dwelling species that do not typically occur in the top of the water column where they might encounter vessels. Biscayne Bay water quality is not likely to be affected by continued Turkey Point operations in any way that would be discernable on the aquatic ecology of Biscayne Bay for the reasons set forth in Section 4.8.1.1. The NRC staff, therefore, concludes that the proposed action would have no adverse effects on EFH. Accordingly, the NRC staff also finds that EFH consultation for the proposed action is not required.

4.8.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed licenses. The Endangered Species Act action area for the no-action alternative would most likely be the same or similar to the action area described in this section for the proposed subsequent license renewal. However, a determination of effects would depend on the specific shutdown activities that would be included in the proposed action as well as the listed species and critical habitats present when the no-action alternative is implemented.

The CCS would continue to operate under the no-action alternative because it supports retired fossil fuel Units 1 and 2. FPL plans to continue to withdraw water from the CCS to support these units' operation in synchronous condenser mode over the course of the proposed subsequent license renewal period, as described in Section 3.1.3, "Cooling and Auxiliary Water Systems." Additionally, Unit 5, which remains in operation, discharges blowdown to the CCS. CCS conditions could change under the no-action alternative because less heat would be discharged to the system, which would potentially make conditions less saline and create more favorable habitat for ESA-listed species; on the other hand, flow would likely decrease following shutdown because Turkey Point Units 3 and 4 would not require as much water, and less flow could lead to stagnant conditions and lower habitat quality for ESA-listed species. Regardless, FPL would continue CCS restoration activities, as described in Section 3.7, "Aquatic Resources." The State of Florida requires these activities under FPL's Nutrient Management Plan which is independent of subsequent license renewal. The CCS would continue to operate during shutdown, as described in Section 4.5.2.1. Therefore, the CCS would likely continue to provide habitat for ESA-listed species.

FPL currently implements a crocodile management plan to help improve breeding and nesting habitat and protect American crocodiles on the Turkey Point site. Many portions of this plan are voluntary and not required by any Federal, State, or local permit. During shutdown, FPL would decide whether to stop or continue implementing the crocodile management plan.

Shutdown of the plant with the currently existing cooling system would likely not affect the marine environments of Biscayne Bay, Card Sound, or the Atlantic Ocean. As such, there would likely be no effects on federally listed species or critical habitats under the National Marine Fisheries Service's jurisdiction or on Essential Fish Habitat.

If necessary, any reinitiated Endangered Species Act, Section 7 consultation with the U.S. Fish and Wildlife Service in connection with the terms and conditions of the current (or any future) biological opinion would determine effects on the American crocodile as well other terrestrial and freshwater species. However, a specific determination of effects would depend on the nature of shutdown activities and the proposed action, the action area associated with those activities, and the listed species, critical habitats, and Essential Fish Habitat present when the no-action alternative is implemented.

4.8.3 Replacement Power Alternatives: Common Impacts

All of the replacement power alternatives would entail construction and operation of a new energy-generating facility on the existing Turkey Point site; certain of these alternatives would also entail offsite construction, in part, which is addressed for each of those alternatives below. The Endangered Species Act action area and Essential Fish Habitat potentially affected by any new plant would be similar to the subsequent license renewal action area because the replacement power generating alternatives would generally be sited on the existing site. However, specifically defining the action area would depend on exact plant siting, planned construction activities, temporary and permanent structure locations, and timeline of the alternative. Similarly, the listed species, critical habitats, and Essential Fish Habitat potentially affected by a particular alternative would depend on the boundaries of that alternative's effects and the species and habitats protected at the time the alternative is implemented. For instance, if Turkey Point continues to operate until the end of the current renewed license terms (2032 for Unit 3 and 2033 for Unit 4) and the replacement power alternative is implemented at that time, the Services may have listed new species, delisted currently listed species whose populations may have recovered, or revised EFH designations. These listing and designation activities would change the potential for the various alternatives to impact special status species and habitats. Additionally, requirements for Endangered Species Act, Section 7 consultation with the Services as well as EFH consultation with the National Marine Fisheries Service would depend on whether Federal permits or authorizations are required in order to implement each particular alternative.

Sections 4.6.3 and 4.7.3 (both titled "Replacement Power Alternatives: Common Impacts") describe the types of impacts that terrestrial and aquatic resources would experience under each alternative. Impacts on special status species and habitats would likely be similar in type. However, the magnitude and significance of such impacts could be larger because special status species and habitats are rare and more sensitive to environmental stressors.

4.8.3.1 New Nuclear Alternative

The NRC staff did not identify any impacts to special status species and habitats for the new nuclear alternative beyond those discussed in the impacts common to all replacement power alternatives. Because the NRC would remain the licensing agency under this alternative, the Endangered Species Act and Magnuson–Stevens Act would require the NRC to consult with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, as applicable, prior to issuing a license for the construction and operation of the new plant in order to consider whether the plant would affect any federally listed species, adversely modify or destroy designated critical habitat, or result in adverse effects on Essential Fish Habitat, if present. If the new power plant required a Clean Water Act, Section 404 permit, the U.S. Army Corps of Engineers may be a cooperating agency for the ESA consultation. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.3.2 Natural Gas Combined-Cycle Alternative

The NRC staff did not identify any impacts to special status species and habitats for the natural gas alternative beyond those discussed in the impacts common to all replacement power alternatives. Unlike Turkey Point subsequent license renewal or the licensing of a new nuclear alternative, the NRC does not license natural gas facilities; therefore, the NRC would not be responsible for initiating Endangered Species Act, Section 7 consultation or Essential Fish Habitat consultation if special status species or habitats might be adversely affected under this alternative. Other Federal agencies could be responsible for addressing impacts on special status species and habitats depending on the specific permits or licenses that the new plant would require. For instance, if the new power plant required a Clean Water Act, Section 404 permit, the ESA would require the U.S. Army Corps of Engineers to consider impacts on Federally-listed species and Essential Fish Habitat. If no Federal permits were required, the companies or entities implementing this alternative would be responsible for ensuring that their actions do not jeopardize the continued existence of listed species because the Endangered Species Act, Section 9 take prohibitions apply to both Federal and non-Federal entities. The Magnuson–Stevens Act only requires EFH consultation for Federal actions. Therefore, EFH consultation would be required if a Federal agency, such as the U.S. Army Corps of Engineers, is involved in the permitting or authorization of this alternative and adverse effects are possible. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.3.3 Combination Alternative (Natural Gas Combined-Cycle Alternative and Solar Photovoltaic Generation)

The NRC staff did not identify any impacts to special status species and habitats for the combination alternative beyond those discussed in the impacts common to all replacement power alternatives and in the natural gas-only alternative. The magnitude and significance of adverse impacts on special status species and habitats resulting from this alternative would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.3.4 Cooling Water System Alternative

The NRC staff did not identify any impacts to special status species and habitats for the cooling water system alternative beyond those discussed in the impacts common to all replacement power alternatives. To the extent that license amendments would be necessary to authorize cooling towers to dissipate excess heat during plant operation, the NRC would be the licensing agency under this alternative and the Endangered Species Act and Magnuson–Stevens Act would require the NRC to consult with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, as applicable, during the staff’s review of that alternative. If the cooling water system alternative required a Clean Water Act, Section 404 permit, the U.S. Army Corps of Engineers could be involved in ESA consultation. The consultations would determine whether the construction and operation of cooling towers would affect any federally listed species, adversely modify or destroy designated critical habitat, or result in adverse effects on Essential Fish Habitat, if present. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the location and layout of the cooling towers, the design of the cooling towers, operational parameters, and the special status species and habitats present in the area when the alternative is implemented.

4.9 <u>Historic and Cultural Resources</u>

This section describes the potential historic and cultural resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.9.1 Proposed Action

Table 4-2 identifies one site-specific (Category 2) issue related to historic and cultural resources applicable to Turkey Point during the subsequent license renewal term. This issue is analyzed below.

4.9.1.1 Category 2 Issue Related to Historic and Cultural Resources: Historic and Cultural Resources

The National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a subsequent renewed license to a nuclear power plant is an undertaking that could potentially affect historic properties. Historic properties are defined as resources included on, or eligible for inclusion on, the National Register of Historic Places (NRHP). The criteria for eligibility are listed in Title 36, "Parks, Forests, and Public Property," of the *Code of Federal Regulations* (36 CFR) Section 60.4, "Criteria for Evaluation," and include (a) association with significant events in history, (b) association with the lives of persons significant in the past, (c) embodiment of distinctive characteristics of a type, period, or method of construction, or (d) sites or places that have yielded, or are likely to yield, important information.

The historic preservation review process (NHPA Section 106) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800, "Protection of Historic Properties." In accordance with NHPA provisions, the NRC establishes the undertaking (subsequent license renewal), identifies the appropriate State or Tribal historic preservation officer, and initiates consultation with the appropriate officer. The NRC is required to make a reasonable effort to identify historic properties included in, or eligible for inclusion in, the NRHP in the area of potential effect (APE). The APE for a subsequent license renewal action includes the power plant site, the transmission lines up to the first substation, and immediate environs that may be affected by the subsequent license renewal decision and land-disturbing activities associated with continued reactor operations during the subsequent license renewal term. In addition, the NRC is required to notify the State historic preservation officer if historic properties would not be affected by subsequent license renewal or if no historic properties are present. In Florida, State historic preservation officer responsibilities lie with the Florida Division of Historical Resources.

4.9.1.2 Consultation

In accordance with 36 CFR 800.8, "Coordination with the National Environmental Policy Act," on May 24, 2018, the NRC initiated consultation with the Advisory Council on Historic Preservation, the Florida State historic preservation officer, and the Miami-Dade County Office of Historic Preservation (NRC 2018j). Also, on May 24, 2018, the NRC initiated consultation with the following Federally-recognized Tribes (NRC 2018j) (see Appendix C, "Consultation Correspondence"):

- Miccosukee Tribe of Indians of Florida
- Muscogee (Creek) Nation

- Poarch Band of Creek Indians
- Seminole Tribe of Florida
- Seminole Nation of Oklahoma

In these letters, the NRC provided information about the proposed action, provided its definition of the APE, and indicated that the NHPA review would be integrated with the NEPA process, in accordance with 36 CFR 800.8(c), "Use of the NEPA Process for Section 106 Purposes." The NRC invited participation in the identification and possible decisions concerning historic properties and also invited participation in the scoping process. The Seminole Tribe of Florida stated in correspondence to the NRC that they "have no comments regarding license renewal at this time" (STOF 2018). The Florida State historic preservation officer stated in correspondence that since the proposed action will not involve ground disturbance it is "unlikely to affect historic properties" (DHR 2018). The Seminole Nation of Oklahoma requested consultation meetings with the NRC (SNO 2018). The NRC held a teleconference with the Seminole Nation of Oklahoma Tribal historic preservation officer on July 2, 2018 (NRC 2018k). Upon learning that the proposed action pertains to the license renewal of the existing Units 3 and 4 and that the plant uses a closed system of cooling canals rather than discharging into Biscayne Bay, the Tribal historic preservation officer did not express concerns regarding the subsequent license renewal of Turkey Point (NRC 2018k). In addition, the Seminole Nation of Oklahoma Tribal historic preservation officer requested a list of flora present at the Turkey Point site; in response, the NRC staff provided a 2017 ecological monitoring survey of the Turkey Point site and vicinity to the Tribe on July 9, 2018 (NRC 2018k). FPL received similar responses from the Florida State historic preservation office, Seminole Nation of Oklahoma, and the Seminole Tribe of Florida regarding the proposed action (FPL 2018h).

4.9.1.3 Findings

As described in Section 3.9, "Historic and Cultural Resources," cultural resource surveys conducted within the 9,460-ac (3,828-ha) Turkey Point site did not identify archeological sites and concluded that the site has a low archeological potential. However, as discussed in Section 3.9, during the NRC staff's environmental site audit, NRC staff became aware of three wooden buildings that were part of a Boy Scouts of America camp and a cottage (known as the Ranger House/McGregor Smith Cottage) of potential historic significance on the Turkey Point site that are over 50 years old (FPL 2018h, NRC 2018c). The Boy Scouts structures and the Ranger House/McGregor Smith Cottage have not been evaluated for eligibility for listing in the NRHP. Given the age of the Ranger House/McGregor Smith Cottage (50 years old) and known association with McGregor Smith Cottage, the NRC believes that the cottage is potentially eligible for listing in the NRHP under Criterion b (association with the lives of persons significant in the past). McGregor Smith was known for his involvement with the Boy Scouts of America and environmental conservation; it is possible that onsite Boy Scouts structures were associated with McGregor Smith (FPL 2018m). Similarly, as a result of McGregor Smith's known involvement with the Boy Scouts, the Boy Scouts structures on the Turkey Point site may potentially be eligible for listing in the NRHP under Criterion b.

Within a 6-mi (9.7-km) radius of the site are two properties determined eligible for listing in the NRHP: K-9 cemetery (approximately 5.9 mi (9.5 km) from Turkey Point) and a canal bridge (approximately 3.6 mi (5.8 km) from Turkey Point). During the environmental site audit, the NRC staff observed that Turkey Point is not visible from these two sites due to tree buffers and distance (NRC 2018c).

FPL did not identify subsequent license renewal-related ground-disturbing activities (FPL 2018f; FPL 2018h). Plant operations and maintenance activities necessary to support subsequent license renewal would likely be limited to previously disturbed areas of the site (FPL 2018f). In the event that ground-disturbing activities are required as a result of plant operations and maintenance activities, FPL has administrative controls in place on how to handle unanticipated historical and cultural finds related to potential ground-disturbing activities. If historic and cultural resources are discovered within the project site, FPL will notify Florida's Division of Historical Resources and the Florida Department of Environmental Protection, Southeast District (FPL 2018f). Additionally, FPL provides training sessions for staff that are involved in potential future ground-disturbing activities; the environmental training sessions are intended to familiarize FPL staff with common artifact types and actions to be taken if cultural resources are identified (FPL 2018h).

Based on (1) Tribal input, (2) no new ground disturbance, (3) FPL's administrative controls, and (4) State historic preservation officer input, the NRC staff concludes that subsequent license renewal for Turkey Point Units 3 and 4 would not adversely affect any known historic properties or historic and cultural resources.

4.9.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and FPL would terminate reactor operations on or before the expiration of the current renewed licenses. As a result of facility shutdown, land-disturbing activities or dismantlement are not anticipated as these would be conducted during decommissioning. Therefore, facility shutdown would have no immediate effect on historic properties or historic and cultural resources.

4.9.3 Replacement Power Alternatives: Common Impacts

If construction and operation of replacement power alternatives require a Federal undertaking (e.g., license, permit), the Federal agency would need to make a reasonable effort to identify historic properties within the area of potential effects and consider the effects of their undertakings on historic properties, in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. 300101 et seq.). Historic and cultural resources identified would need to be recorded and evaluated for eligibility for listing on the NRHP. If historic properties are present and could be affected by the undertaking, adverse effects would be assessed, determined, and resolved in consultation with the State historic preservation officer and any Indian Tribe that attaches religious and cultural significance to identified historic properties through the Section 106 process.

<u>Construction</u>

Impacts to historic and cultural resources from the construction of replacement power alternatives are primarily related to ground disturbance (land clearing, excavations, etc.). For the new nuclear alternative, natural gas combined-cycle alternative, and the natural gas combined-cycle portion and one installation of the solar photovoltaic portion of the combination alternative, this environmental review assumes that the new facilities would be built on the Turkey Point site. For the solar portion of the combination alternative, this environmental review assumes that three of the new facilities would occur at other sites in Miami-Dade County and/or Broward County. As discussed in Section 3.9.2, "Historic and Cultural Resources," of this SEIS, while a comprehensive cultural resource survey of the entire 9,460-ac (3,828-ha) Turkey Point site has not been conducted, cultural resource surveys that have been completed have concluded that the Turkey Point site has a low archeological potential. Land areas not previously surveyed (onsite and offsite) that are affected by the construction of power alternatives would need to be surveyed to identify and record historic and cultural resources.

Operation

The potential for impacts on historic and cultural resources from the operation of replacement power alternatives would be related to maintenance activities at the site as well as visual impacts that would vary with plant heights and associated exhaust stack or cooling towers. The replacement power alternatives located at the Turkey Point site would be in an industrialized area where tall structures already exist and visible plumes from the Turkey Point Unit 5 cooling towers occur.

4.9.3.1 New Nuclear Alternative

Impacts on historic and cultural resources from the construction and operation of a new nuclear alternative would include those common to all replacement power alternatives. The new nuclear alternative would require an estimated 360 ac (240 ha) of land on the Turkey Point site. Within a 6-mi (9.7-km) radius of the site are two offsite properties (at distances of 3.6 mi (5.8 km) and 5.9 mi (9.5 km) from the Turkey Point site) determined to be eligible for listing in the NRHP. The tallest structures would be the containment buildings at approximately 230 feet (70 m). A visible plume would occur from the draft cooling towers, particularly during winter months, which could have a median plume length of 820 feet (250 m) (NRC 2016a). Tall structures and cooling tower plumes that currently exist on the Turkey Point site are not visible from the two NRHP-eligible sites. Given the presence of tree buffers and distance, the NRC staff does not anticipate that the new structures and plumes as a result of the new nuclear alternative would be visible from these offsite NRHP-eligible properties. As discussed in Section 4.9.1.3 of this SEIS, there are historic structures on the Turkey Point site that are potentially eligible for listing on the NRHP. Construction of the new nuclear alternative on or near these structures, however, could be avoided. Depending on where the new nuclear alternative is located within the FPL site, construction and operation of this alternative could introduce additional containment buildings, stacks, and facility support structures and affect the viewshed of these historic structures. However, the Turkey Point site is an industrialized area restricted to the public where tall structures and plumes already exist. Therefore, construction and operation of the new nuclear alternative would be compatible with the current site and not out of character with the current setting.

Given that the Turkey Point site has a low archeological potential, that current site infrastructure use would be maximized, and that avoidance of significant historic resources would be possible, the NRC staff concludes that construction of the new nuclear alternative on the Turkey Point site would not adversely affect historic and cultural resources.

4.9.3.2 Natural Gas Combined-Cycle Alternative

Impacts on historic and cultural resources from the construction and operation of a new natural gas alternative would include those common to all replacement power alternatives. The natural gas facility would require an estimated 75 ac (30 ha) for the power block and support facilities and an additional 1,200 ac (490 ha) for a natural gas pipeline. Construction of the natural gas pipeline would use existing utility corridors to the extent possible. Within a 6-mi (9.7-km) radius of the site are two properties (approximately 3.6 mi (5.8 km) and 5.9 mi (9.5 km) from the Turkey Point site) determined to be eligible for listing in the NRHP. The tallest natural gas alternative structure would be the plant stacks at approximately 150-feet tall (46-m). The current Turkey Point containment structures are not visible from the two NRHP-eligible sites. Because the natural gas plant stacks would be shorter than the current Turkey Point containment structures, the NRC staff does not anticipate that the natural gas plant stacks would be visible from the NRHP-eligible sites. A visible plume would occur from the draft cooling towers, particularly during winter months, which could have a median plume length of 820 feet (250 m) (NRC 2016a). However, the NRC staff does not anticipate that the plume would be visible from these offsite NRHP-eligible sites given the presence of tree buffers and distance.

As discussed in Section 4.9.1.3 of this SEIS, there are historic structures on the Turkey Point site that are potentially eligible for listing in the NRHP. Construction of the natural gas alternative on or near these structures, however, could be avoided. Depending on where the natural gas alternative is located within the FPL site, construction and operation of this alternative would introduce additional containment buildings, stacks, and facility support structures and affect the viewshed of these historic structures. However, the Turkey Point site is an industrialized area, restricted to the public, where tall structures and plumes already exist. Therefore, construction and operation of the natural gas alternative would be compatible with the current site and not out of character with the current setting.

Given that the Turkey Point site has a low archeological potential and that existing infrastructure use would be maximized, including the preferential use of previously disturbed land for the pipeline, the avoidance of significant historic resources would be possible. Therefore, the NRC staff concludes that construction and operation of the natural gas alternative on the Turkey Point site would not adversely affect historic and cultural resources.

4.9.3.3 Combination Alternative

Impacts on historic and cultural resources from the construction and operation of the natural gas components of the combination alternative would be the same as the natural gas-only alternative given that land requirement, location, and facility height structures would be the same. Therefore, the NRC staff concludes that construction and operation of the natural gas portion of the combination alternative on the Turkey Point site would not adversely affect historic and cultural resources. As stated in Section 2.2.2.3 of this SEIS, the NRC staff assumes that the solar portion that would be located on the Turkey Point site would maximize use of the existing infrastructure, would have a low visual profile, and would be located on a site that has a low archeological potential. Construction and operation of the solar alternative on or near historic and cultural resources could be avoided. Therefore, construction and operation of the solar component on the Turkey Point site would not adversely affect historic and cultural resources.

Impacts on historic and cultural resources from the construction and operation of the solar portion of the combination alternative would include those common to all replacement power alternatives. The solar portion of the combination alternative would require an estimated 470 ac (190 ha) for each of the four solar facilities. The impacts from the construction and operation of the solar component on historic and cultural resources would vary, depending on where solar facilities are constructed. The three offsite solar facilities would be installed in Miami-Dade and/or Broward Counties, but the exact locations are unknown. Depending on the site and historic and cultural resources present, construction and operation of the solar facilities could alter these resources within the area of potential effect. Areas with the greatest cultural sensitivity could be avoided or effectively managed. Therefore, for these three sites, the historic and cultural resource impact could range from no adverse effect to adverse effect.

4.9.4 Cooling Water System Alternative

If construction and operation of the cooling water system alternative were to require NRC licensing actions (e.g., a license amendment), the NRC would need to comply with Section 106 of NHPA consultation requirements. The Section 106 process would be initiated after submission of an application or request from FPL.

Land areas needed to support construction of the mechanical draft cooling towers would need to be surveyed for historic and archeological resources. Any resources found during these surveys would need to be evaluated for their eligibility for listing on the NRHP, and any adverse effects would need to be mitigated. Constructing the cooling towers on previously disturbed land could reduce the potential impact to historic and archaeological resources. As discussed in Section 3.9.2 of this SEIS, while a comprehensive cultural resource survey of the entire 9,460-ac (3,828-ha) Turkey Point site has not been conducted, cultural resource surveys that have been completed have concluded that the Turkey Point site has a low archeological potential. Within a 6-mi (9.7-km) radius of the site there are two offsite properties (approximately 3.6 mi (5.8 km) and 5.9 mi (9.5 km) from the Turkey Point site) which were determined to be eligible for listing in the NRHP. The cooling towers would be approximately 70 feet (20 m) in height and plumes could be visible during the winter months with a median length of 820 feet (250 m) (NRC 2016a). However, the plume is not anticipated to be visible from these offsite NRHP-eligible sites given the presence of tree buffers and distance.

As discussed in Section 4.9.1.3 of this SEIS, there are historic structures on the Turkey Point site that are potentially eligible for listing in the NRHP. Construction of the cooling towers on or near these structures could be avoided. Depending on where the cooling towers are located within the FPL site, construction and operation of this alternative would introduce additional cooling towers and visible plumes and would affect the viewshed of these historic structures. However, the Turkey Point site is an industrialized area, restricted to the public, where tall structures and visible plumes already exist. Therefore, construction and operation of the cooling towers would be compatible with the current site and not out of character with the current setting.

The Turkey Point site has a low archeological potential and avoidance of construction and operations impacts of the cooling water system alternative to significant historic resources would be possible. The plume from the Turkey Point cooling towers is not anticipated to be visible from offsite historic properties within a 6-mi radius of Turkey Point. Therefore, the NRC staff concludes that construction and operation of the cooling water system alternative on the Turkey Point site would not adversely affect historic and cultural resources.

4.10 <u>Socioeconomics</u>

This section describes the potential socioeconomic impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.10.1 Proposed Action

According to the GEIS (NRC 2013a), the impacts of license renewal on socioeconomic issues would be SMALL. The NRC staff identified no new or significant information for these issues.

Socioeconomic effects of ongoing reactor operations at Turkey Point have become well established as regional socioeconomic conditions have adjusted to the presence of the nuclear power plant. Any changes in employment and tax revenue caused by subsequent license renewal and any associated refurbishment activities could have a direct and indirect impact on community services and housing demand, as well as traffic volumes in the communities around the nuclear power plant. FPL indicated in its environmental report that it has no plans to add non-outage workers during the subsequent license renewal term, does not anticipate changes in tax payments during the subsequent license renewal term, and will not conduct refurbishment activities. Consequently, people living in the vicinity of Turkey Point and in Miami-Dade County are not likely to experience any changes in socioeconomic conditions during the subsequent license renewal term beyond what is currently being experienced under the current renewed licenses.

As identified in Table 4-1 of this SEIS, the socioeconomic impacts of continued reactor operations during the subsequent license renewal term would be SMALL. Table 4-2 of this SEIS does not identify any site-specific (Category 2) socioeconomic issues for Turkey Point.

4.10.2 No-Action Alternative

4.10.2.1 Socioeconomics

Under the no-action alternative, the NRC would not issue subsequent renewed licenses and FPL would shut down Turkey Point on or before the expiration of the current renewed licenses. Termination of nuclear power plant operations would result in cessation of electrical power production and a loss of jobs, income, and tax revenues. Socioeconomic impacts from the termination of reactor operations would be concentrated in Miami-Dade County since the majority of Turkey Point Units 3 and 4 workers reside in this county. Employment and income from the buying and selling of goods and services needed to operate and maintain the nuclear power plant would also be reduced.

As jobs are eliminated, some, but not all, of the total 1,046 FPL workers (permanent and contractors) could begin to leave the region. If FPL workers and their families move out of the region, increased housing vacancies and decreased demand could cause housing prices to fall. However, the FPL workforce that resides in Miami-Dade County (approximately 85 percent of the total Turkey Point permanent workforce) represents only approximately 0.05 percent of Miami-Dade County's 2016 civilian labor force (see Section 3.10.2.1, "Regional Employment and Income"). The remaining FPL workers similarly comprise a very small percentage (less than 0.1 percent) of the civilian labor force in other nearby counties. Therefore, the migration of these workers out of those nearby counties would not have a noticeable socioeconomic impact in those counties.

The loss of tax revenue could result in the reduction or elimination of some public and educational services. However, as noted in Section 3.10.5, "Tax Revenues," FPL property tax payments to Miami-Dade County and Miami-Dade County Public School District as a result of Turkey Point Units 3 and 4 operations represent less than 1 percent of Miami-Dade County total revenues and Miami-Dade County Public School District total revenues. Because Turkey Point is located in a large metropolitan area, socioeconomic impacts from not subsequently renewing the Units 3 and 4 operating licenses and terminating reactor operations would be SMALL.

4.10.2.2 Transportation

Traffic volume as a result of commuting workers and truck deliveries on roads in the vicinity of Turkey Point Units 3 and 4 would be reduced after plant shutdown. The reduction in traffic would be associated with the loss of jobs. Similarly, truck deliveries to Turkey Point would be reduced. Therefore, traffic-related transportation impacts would be SMALL as a result of the shutdown of Turkey Point Units 3 and 4.

4.10.3 Replacement Power Alternatives: Common Impacts

The following provides a discussion of the common socioeconomic and transportation impacts during construction and operation of replacement power generating facilities.

4.10.3.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes in the social and economic conditions of a region. For example, the creation of jobs and the purchase of goods and services during the construction and operation of a replacement power plant could affect regional employment, income, and tax revenue. For each alternative, two types of jobs would be created: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. The socioeconomic region of influence is Miami-Dade County for the new nuclear alternative and natural gas combined-cycle alternative. The socioeconomic region of influence for the combination alternative would be Miami-Dade and Broward counties.

<u>Construction</u>

The relative economic effect of an influx of workers on the local economy and tax revenue would vary and depend on the size of the workforce and construction completion time. The greatest impact would occur in the communities where the majority of construction workers would reside and spend their incomes. While some construction workers would be local, additional workers may be required from outside the immediate area depending on the local availability of appropriate trades and occupational groups. The region of influence could experience a short-term economic boom during construction from increased tax revenue, income generated by expenditures for goods and services, and the increased demand for temporary (rental) housing. After construction, the region of influence would likely experience a return to preconstruction economic conditions.

<u>Operation</u>

Prior to the commencement of startup and operations, local communities could see an influx of operations workers and their families resulting in an increased demand for permanent housing and public services. These communities would also experience the economic benefits from increased income and tax revenue generated by the purchase of goods and services needed to operate a new replacement power plant. Consequently, power plant operations would have a greater potential for effecting permanent, long-term socioeconomic impacts on the region.

4.10.3.2 Transportation

Transportation impacts are defined in terms of changes in level of service conditions on local roads in the region. Additional vehicles on local roadways during construction and operations could lead to traffic congestion, level of service impacts, and delays at intersections.

<u>Construction</u>

Transportation impacts during the construction of a replacement power plant would consist of commuting workers and truck deliveries of equipment and material to the construction site. Workers would arrive via site access roads, and the volume of traffic would increase during shift changes. In addition, trucks would transport equipment and material to the construction site, thus increasing the amount of traffic on local roads. The increase in traffic volumes could result in levels of service impacts and delays at intersections during certain hours of the day. In some instances, construction material could also be delivered by rail or barge.

<u>Operation</u>

Traffic-related transportation impacts would be greatly reduced after construction has been completed. Transportation impacts would include daily commuting by the operations workforce and deliveries of material, and the removal of commercial waste material by truck. Increased commuter traffic would occur during shift changes and deliveries of materials and equipment to the power plant.

4.10.4 New Nuclear Alternative

<u>Socioeconomics</u>

Construction of a new nuclear alternative would require a large workforce, approximately a peak at 3,900 workers. However, peak workforce construction jobs would represent approximately 0.3 percent of employment in Miami-Dade County. Tax revenue increases in the form of sales taxes and property taxes in the region would occur. However, because of the large tax revenue of Miami-Dade County (see Section 3.10.5), the impact on tax revenues during construction, while beneficial, would be relatively minimal. For instance, the NRC staff concluded that construction expenses for Turkey Point Units 6 and 7 corresponded to approximately seven-tenths of 1 percent of Miami-Dade County sales and use tax revenues (NRC 2016a). As presented in Section 3.10.3.1, "Transient Population," and 3.10.4.1, "Housing," Miami-Dade County has available vacant rental units and housing to support a 3,900 peak construction workforce. Increases in property tax revenue are not anticipated during construction since property taxes due to the new nuclear units would not occur until after construction is completed (NRC 2016a). As a result of the construction workforce, service or retail-related jobs would be indirectly created (NRC 2016a). The NRC staff estimated that peak construction annual wage earnings of a workforce of 3,950 for Turkey Point Units 6 and 7 and indirect jobs would be less than eight-tenths of 1 percent of total annual wage earnings in Miami-Dade County (NRC 2016a). The construction of a new nuclear power plant would create a large number of jobs (directly and indirectly) and the socioeconomic impacts would be beneficial. The large workforce and jobs would be noticeable to the local communities in and near Homestead, FL. Therefore, the socioeconomic impacts from construction of a new nuclear alternative are SMALL to MODERATE.

Approximately 800 workers would be required during nuclear power plant operations, which would represent approximately 0.05 percent of the jobs in Miami-Dade County. Salary earnings of the workforce would be introduced into the Miami-Dade County economy, but they would not be noticeable. For instance, the NRC staff estimated that annual earnings of 806 operation workers for Turkey Point Units 6 and 7 would be a tenth of one percent of total wage earnings in Miami-Dade County (NRC 2016a). Tax revenues would increase as a result of operations of the new nuclear alternative. However, revenue generated by sales taxes and property taxes from operations of a new nuclear alternative would be minor. For instance, the NRC staff concluded that sales from operation of the proposed Turkey Point Units 6 and 7 would generate up to $2 million in sales tax and $50.4 million in property taxes. When compared to Miami-Dade County tax revenues (see Section 3.10.5, "Tax Revenues"), this is a small percentage. Furthermore, the number of operational and outage workers for a new nuclear alternative, property tax revenue, sales tax revenue, and the socioeconomic impacts would be similar to those currently experienced for Units 3 and 4. Therefore, the socioeconomic impacts from operating of a new nuclear power plant would be SMALL.

<u>Transportation</u>

During periods of peak construction activity, up to 3,900 workers would be commuting daily to the construction site. Workers commuting to the site and delivery vehicles would arrive via site access roads and the volume of traffic on nearby roads would increase substantially. The increase in vehicular traffic would peak during shift changes and during the peak building workforce use, resulting in temporary levels of service impacts and delays at intersections. In addition to the workforce, delivery vehicles transporting construction material would also use roads in the vicinity. A traffic study found that an additional 3,650 peak construction workforce and delivery vehicles for construction of Turkey Point Units 6 and 7 would not result in the exceedance capacity of local roads (along Palm Drive/SW 344th, SW 328th St, and SW 312th St) in the vicinity of the Turkey Point site; however, in order to maintain an adequate level of service for these roads, road improvements (additional turn lanes, roadway widening) would need to be implemented (Traf Tech 2009). Therefore, additional vehicles as a result of construction would noticeably alter traffic on roads in the vicinity Turkey Point, result in a loss of service for the nearby roads, and, without mitigation measures, would destabilize the transportation infrastructure. Therefore, the impact on transportation infrastructure in the immediate vicinity of the Turkey Point site during construction of a new nuclear power plant would be LARGE.

Approximately 800 workers would be commuting daily to the Turkey Point site during operations. Traffic on roadways would peak during shift changes and refueling outages, resulting in temporary levels of service impacts and delays at intersections. However, the operational and outage workforce would be similar to Turkey Point and the transportation impacts for a new nuclear alternative would be similar to what is currently being experienced as a result of operation for Units 3 and 4. Therefore, transportation impacts in the immediate vicinity of the Turkey Point site during nuclear power plant operations for the new nuclear alternative would be SMALL.

4.10.5 Natural Gas Combined-Cycle Alternative

<u>Socioeconomics</u>

Socioeconomic impacts would result from the approximately 1,200 construction workers and 150 workers to operate the natural gas alternative. Overall, the size of the workforce for both construction and operations would be smaller than the new nuclear alternative. The natural gas alternative would require 75 ac (30 ha) for the power block. While the natural gas alternative power block would require less land than Turkey Point, an additional 1,200 ac (490 ha) would be needed for right-of-way to connect with an existing natural gas supply line. This could result in additional property tax revenue. However, given Miami-Dade County's large funding source revenues (see Section 3.10.5 for a discussion of Miami-Dade County property tax revenues), additional property tax revenue from the natural gas alternative is not anticipated to be noticeable. The capital costs of a natural gas-fired power plant, the building and operations workforces, and the local expenditures on materials and equipment are lower at a natural-gas plant than those of a nuclear facility (EIA 2016d, EIA 2017f). Therefore, these impacts would be similar but of lesser magnitude than the new nuclear alternative. Therefore, the socioeconomic impacts from construction and operation of a natural gas alternative would be SMALL.

Transportation

Traffic-related impacts would result from the 1,200 construction workers and 150 workers during operation of the natural gas alternative, as well as delivery vehicles. The construction workforce for a natural gas-fired power plant would be less than the construction and operational workforce (when considering refueling outage workers) for a new nuclear alternative. The NRC staff concludes that the transportation impacts in the immediate vicinity of the Turkey Point site from construction would be noticeable, but not destabilizing, and therefore MODERATE.

The operations workforce for the natural gas alternative would be substantially less than the operations workforce of a new nuclear alternative. While there would be some increase in traffic in the vicinity of the Turkey Point site for the natural-gas plant during operation, that increase would be less than the increase for the new nuclear alternative. Additionally, worker vehicles from operation of the natural gas alternative would be less than what is experienced from operation of Turkey Point. The NRC staff concludes that the transportation impacts in the immediate vicinity of the Turkey Point site from operation would be SMALL.

Therefore, the NRC staff concludes that, overall, the transportation impacts in the immediate vicinity of the Turkey Point site from constructing and operating the natural gas alternative would range from SMALL to MODERATE.

4.10.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

Socioeconomics

The workforce required to construct and operate the natural gas portion of the combination alternative and land requirements would be similar to the full-power natural gas-only alternative discussed in Section 4.10.5 since the natural gas unit under the combination alternative would be approximately 95 percent of that of the natural gas-only alternative. Therefore, the NRC staff concludes that the socioeconomic impacts from construction and operations of the natural gas portion of the combination alternative would be SMALL.

Installation of the solar portion of the combination alternative would require up to 200 construction workers. Miami-Dade County's regional employment, tax revenue, and housing is discussed in Chapter 3, "Affected Environment." Broward County has a civilian labor force of approximately 997,404 individuals and 143,898 vacant housing units (USCB 2016h). In 2017, Broward County's property tax revenue was $0.929 billion, and its total operating revenue was $4.704 billion (Broward County 2017). A construction workforce of 200 would not result in a noticeable or substantial increase in housing demand, jobs, or wages given Miami-Dade and Broward counties' available housing and labor force. Additionally, local expenditures for goods and expenditures for construction of the solar portion would not result in noticeable tax revenue given both Miami-Dade and Broward counties' large funding source revenues. Therefore, the socioeconomic impacts from constructing the solar portion would be SMALL.

A small number of workers would be needed to maintain and operate the solar systems (10 workers). This would not result in a noticeable or substantial increase in housing demand, jobs, or wages. Operation of solar systems would generate tax revenue from operation expenditures and the large amount of land required to support this alternative (total of 1,410 ac). However, Miami-Dade and Broward counties both have large funding source revenues. The additional tax revenue from operation of solar units is not anticipated to be noticeable given both counties' revenues. Therefore, the socioeconomic impacts from operation of the solar portion of the combination alternative would be SMALL.

Transportation

Traffic-related impacts for the natural gas portion of the combination alternative would result from worker and delivery vehicles. Since the workforce required to construct and operate the natural gas power plant component of the combination alternative would be approximately the same as the natural gas-only alternative discussed in Section 4.10.5, the NRC staff concludes that the overall transportation impacts in the immediate vicinity of the Turkey Point site from constructing and operating the natural gas portion of the combination alternative would be SMALL to MODERATE.

In addition to delivery vehicles, the solar component of the combination alternative would require an estimated 200 workers during construction and 10 workers during operation. The construction and operations workforce would not result in a substantial increase in traffic in the vicinity of the Turkey Point site. An additional 200 worker vehicles during construction at the two additional sites in Broward County could be noticeable depending on the exact location of the sites and access roads and result in level of service changes and therefore impacts could be SMALL to MODERATE. However, an additional 10 worker vehicles during operations is not anticipated to have noticeable changes in traffic; the transportation impacts from operation of the solar portion of the combination alternative would be SMALL. Therefore, the staff concludes that the overall transportation impacts from constructing and operating the solar component of the combination alterative would be SMALL to MODERATE.

4.10.7 Cooling Water System Alternative

4.10.7.1 Socioeconomics

Site preparation, necessary plant modifications, and cooling tower installation would result in short-term employment increases. The workforce necessary to construct a closed-cycle mechanical-draft cooling tower system at Turkey Point is unknown. Construction workforce estimates on the construction of cooling tower technologies have been prepared for other nuclear power plants. A mechanical-draft cooling tower system consisting of two cooling tower units at the Oyster Creek Nuclear Generating Station (single unit) was estimated to require 100 workers during non-peak construction months (NRC 2006b). Bechtel (2014) estimated that for a closed-cycle cooling alternative (consisting of two wet mechanical draft cooling towers per unit) at Diablo Canyon Power Plant, approximately 1,117 construction workers (585 workers per shift and 2 work shifts) would be needed. Based on these estimates, construction of cooling towers at Turkey Point could require approximately between 200 and 1,110 construction workers.

The majority of construction workers would relocate temporarily to Miami-Dade County, resulting in a short-term increase in the population and increased demand for temporary housing. However, given Miami-Dade County's population and available housing (see Sections 3.10.3, 3.10.3.1, and 3.10.4) an additional 1,110 construction workers would not result in a noticeable increase in population or shortages in temporary housing. Using the new nuclear alternative discussed in Section 4.10.4 as a bounding analysis for the construction of the cooling water system alternative, increases in property tax revenue, sales taxes, and wages as a result of construction would be minor. Therefore, the socioeconomic impacts of constructing the cooling water system alternative would be SMALL.

Once the construction of the closed-cycle cooling towers and plant modifications has been completed, the size of the workforce at Turkey Point would return to normal. A small number of additional workers would likely be needed to maintain and monitor the cooling towers. At Oyster Creek Nuclear Generating Station (single unit), an additional 25 employees were estimated to be needed for operation of the closed-cycle cooling system (NRC 2006b). Therefore, 50 additional operations workers would be a reasonable estimate for the number of additional employees needed at Turkey Point Units 3 and 4. This would result in no noticeable increase in population or housing demand. Annual property taxes could increase with an increased assessed value of Turkey Point with the addition of a closed-cycle cooling system. However, additional revenue generated from operating the closed-cycle system would not be noticeable. Therefore, the socioeconomic impacts of operating the cooling water system alternative would be SMALL.

4.10.7.2 Transportation

Transportation impacts associated with the construction and operation of the cooling water system alternative would consist of commuting workers and truck deliveries of construction materials to the Turkey Point site. Construction of the cooling water system alternative at Turkey Point could require up to 1,110 construction workers. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays on local roads and at intersections. Up to 1,110 construction workers, in addition to the existing Turkey Point Units 3 and 4 workforce, commuting to the site would noticeably increase traffic on the roads. Therefore, transportation impacts in the immediate vicinity of the Turkey Point site during construction of the cooling towers could range from SMALL to MODERATE and would depend on the number of worker vehicles and truck deliveries. Once the construction of the cooling towers and plant modifications has been completed, the size of the workforce and truck deliveries would return to normal. A small number of additional workers may be needed to maintain and monitor the cooling towers. Operation of the closed-cycle cooling system would have little to no effect on transportation infrastructure and, therefore, transportation impacts would be SMALL.

Overall, transportation impacts in the immediate vicinity of the Turkey Point site from the construction and operation of the cooling water system alternative could range from SMALL to MODERATE.

4.11 Human Health

This section describes the potential human health impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.11.1 Proposed Action

According to the GEIS (NRC 1996 and NRC 2013a), the generic issues related to human health as identified in Table 4-1 would have SMALL impacts resulting from license renewal. As discussed in Chapter 3, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of those generic issues related to human health would be SMALL.

Table 4-2 identifies one uncategorized issue (chronic exposure to electromagnetic fields) and one site-specific (Category 2) issue (electric shock hazards) related to human health applicable to Turkey Point subsequent license renewal. These issues are analyzed below.

4.11.1.1 Uncategorized Issue Relating to Human Health: Chronic Effects of Electromagnetic Fields (EMFs)

The GEIS (NUREG-1437) (NRC 2013a) does not designate the chronic effects of 60-Hz electromagnetic fields (EMFs) from power lines as either a Category 1 or Category 2 issue. Until a scientific consensus is reached on the health implications of electromagnetic fields, the NRC will not include them as Category 1 or 2 issues.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE).

The report by the National Institute of Environmental Health Sciences, “NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields” (NIEHS 1999), contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement was not sufficient to cause the NRC to change its position with respect to the chronic effects of electromagnetic fields. The NRC staff considers the GEIS finding of “UNCERTAIN” still appropriate and will continue to follow developments on this issue.

4.11.1.2 Category 2 Issue Related to Human Health: Electric Shock Hazards

Based on the GEIS (NUREG-1437) (NRC 2013a), the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been identified to be a problem at most operating plants and generally is not expected to be a problem during the subsequent license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of the Turkey Point subsequent license renewal review.

As discussed in Section 3.11.4, "Electromagnetic Fields," there are no offsite transmission lines that are in scope for this SEIS. Therefore, there are no potential impacts to members of the public.

As discussed in Section 3.11.5, "Other Hazards," Turkey Point maintains an occupational safety program for its workers in accordance with Occupational Safety & Health Administration regulations, which includes protection from acute electric shock. Therefore, the NRC staff concludes that the potential impacts from acute electric shock during the subsequent license renewal term would be SMALL.

4.11.1.3 Environmental Consequences of Postulated Accidents

The GEIS (NUREG-1437) (NRC 2013a) evaluates the following two classes of postulated accidents as they relate to license renewal:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core, whether or not there are serious off-site consequences.

As shown in Table 4-1, the GEIS (NRC 2013a) addresses design-basis accidents as a Category 1 issue and concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants.

As shown in Table 4-2, the GEIS designates severe accidents as a Category 2 issue requiring site-specific analysis. Based on information in the 2013 GEIS, the NRC determined in 10 CFR Part 51 that for all nuclear power plants, the probability-weighted consequences of severe accidents associated with license renewal are SMALL, with a caveat:

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. (NRC 2013a)

As part of its initial license renewal application submitted in 2000, FPL's environmental report included an assessment of severe accident mitigation alternatives (SAMAs) for Turkey Point (FPL 2000). During its review of FPL's initial license renewal application, the NRC staff performed a site-specific analysis of Turkey Point SAMAs and documented its findings in a supplement to the GEIS (Supplement 5, “Regarding Turkey Point Nuclear Plant, Units 3 & 4,” to NUREG–1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants”) (NRC 2002c). Because the staff has previously considered SAMAs for Turkey Point Units 3 and 4, FPL is not required to perform another SAMA analysis as part of its subsequent license renewal application (10 CFR 51.53(c)(3)(ii)(L)).

However, the NRC’s regulations in 10 CFR Part 51, which implement Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA), require that all applicants for license renewal submit an environmental report to the NRC and in that report identify any “new and significant information regarding the environmental impacts of license renewal of which the applicant is aware” (10 CFR 51.53(c)(3)(iv)). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA assessment. Accordingly, in its subsequent license renewal application environmental report, FPL evaluated areas of new and potentially significant information that could affect the environmental impact of postulated severe accidents during the subsequent license renewal period. The NRC staff provides a discussion of new information pertaining to SAMAs in Appendix E, “Environmental Impacts of Postulated Accidents,” in this SEIS.

Based on the NRC staff’s review and evaluation of FPL’s analysis of new and potentially significant information regarding SAMAs and the staff’s independent analyses as documented in Appendix E, “Environmental Impacts of Postulated Accidents,” to this SEIS, the staff finds that there is no new and significant information for Turkey Point related to SAMAs.

4.11.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed licenses. Human health risks would be smaller following plant shutdown. The reactor units, which currently operate within regulatory limits, would emit less radioactive gaseous, liquid, and solid material to the environment. In addition, following shutdown, the variety of potential accidents at the plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 4.11.1, “Proposed Action,” the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL, except for “Chronic effects of electromagnetic fields (EMFs),” for which the impacts are UNCERTAIN. In Section 4.11.1.3, “Environmental Consequences of Postulated Accidents,” the NRC staff concluded that the impacts of accidents during operation are SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and types of accidents decrease following shutdown, the NRC staff concludes that the risk to human health following plant shutdown would be SMALL.

4.11.3 Replacement Power Alternatives: Common Impacts

Impacts on human health from construction of a replacement power station would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules, the use of personal protective equipment, training, and placement of engineered barriers would limit those impacts on workers to acceptable levels.

The human health impacts from the operation of a power station include public risk from inhalation of gaseous emissions. Regulatory agencies, including the U.S. Environmental Protection Agency and Florida State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits to protect human health.

4.11.4 New Nuclear Alternative

The construction impacts of the new nuclear alternative would include those identified in Section 4.11.3 above. Since the NRC staff expects that the licensee would limit access to active construction areas to only authorized individuals, the impacts on human health from the construction of the new nuclear alternative would be SMALL.

The human health effects from the operation of the new nuclear alternative would be similar to those of operating the existing Turkey Point Units 3 and 4. As presented in Section 4.11.1, impacts on human health from the operation of Turkey Point would be SMALL, except for "chronic effects of electromagnetic fields (EMFs)," for which the impacts are UNCERTAIN. Therefore, the NRC staff concludes that the impacts on human health from the operation of the new nuclear alternative would be SMALL.

4.11.5 Natural Gas Combined-Cycle Alternative

The construction impacts of the natural gas alternative would include those identified in Section 4.11.3, "Replacement Power Alternatives: Common Impacts," as common to the construction of all replacement power alternatives. Since the NRC staff expects that the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of the natural gas alternative would be SMALL.

The human health effects from the operation of the natural gas alternative would include those identified in Section 4.11.3 as common to the operation of all replacement power alternatives. Health risk may be attributable to nitrogen oxide emissions that contribute to ozone formation (NRC 2013a). Given the regulatory oversight exercised by the EPA and State agencies, the NRC staff concludes that the human health impacts from the natural gas alternative would be SMALL.

4.11.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

Impacts on human health from construction of the combination natural gas and solar alternative would include those identified in Section 4.11.3 as common to the construction of all replacement power alternatives. Since the NRC staff expects that the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of the combination natural gas and solar alternative would be SMALL.

Operational hazards at a natural gas facility are discussed in Section 4.11.5, "Natural Gas Combined-Cycle Alternative."

Solar photovoltaic panels are encased in heavy-duty glass or plastic. Due to this, there is little risk that the small amounts of hazardous semiconductor material that they contain will be released into the environment. In the event of a fire, hazardous particulate matter could be released to the atmosphere. Given the short duration of fires and the high melting points of the materials found in the solar photovoltaic panels, the impacts from inhalation are minimal. Also, the risk of fire at ground-mounted solar installations is minimal due to precautions taken during site preparation, such as the removal of fuels and the lack of burnable materials contained in the solar photovoltaic panels. Another potential risk associated with photovoltaic systems and fire is the potential for shock or electrocution from contact with a high voltage conductor. Proper procedures and clear marking of system components should be used to provide emergency responders with appropriate warnings to diminish the risk of shock or electrocution (OIPP 2010).

Photovoltaic solar panels do not produce electromagnetic fields at levels considered harmful to human health as established by the International Commission on Non-Ionizing Radiation Protection. These small electromagnetic fields diminish significantly with distance and are indistinguishable from normal background levels within several yards (OIPP 2010).

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the combination natural gas and solar alternative would be SMALL.

4.11.7 Cooling Water System Alternative

The impacts of the cooling water system alternative would be similar to those identified in Section 4.11.3, “Replacement Power Alternatives: Common Impacts,” as common to all alternatives. Limiting access to the active construction area to only authorized individuals is expected.

The human health effects from the operation of the cooling water system alternative would include microbiological organisms and exposure to any biocides added to the system to limit the growth of those microbiological organisms. The GEIS (NUREG-1437) evaluation of health effects from plants with cooling systems discusses the potential hazard to workers from microbiological organisms inhabiting the system whose presence might be enhanced by the thermal conditions found in the cooling system. The microbiological organisms of concern are freshwater organisms that are present at sites that use cooling ponds, lakes, or canals and that discharge to small rivers (NRC 2013a). These concerns would not apply to the cooling water system alternative at Turkey Point, which would be closed cycle, would use treated, reclaimed wastewater, and would not be accessible by members of the public. Also, the cooling system would contain cooling water treatment and conditioning chemical residuals (e.g., biocides, corrosion inhibitors) necessary for proper operation, maintenance, and microorganism control of the cooling towers and Turkey Point circulating water system. Incoming makeup water for the cooling water system alternative will be treated reclaimed wastewater that will be stored in an onsite reservoir. FPL has procedures onsite for the safe handling of any chemical usage for operations, and any chemical use for the cooling water alternative is expected to be added to these procedures. Also, the NRC staff assumes that any blowdown produced by the cooling towers would be disposed of by deep well injection into the Boulder Zone, which would be regulated under a Class I underground injection control permit issued by the Florida Department of Environmental Protection (FAC 62-528).

In consideration of the information and assumptions presented above, the NRC staff concludes that the impacts on human health from the construction and operation of the cooling water system alternative would be SMALL.

4.12 Environmental Justice

In Section 3.12, “Environmental Justice,” of this SEIS, the NRC staff explains the basis for its consideration of environmental justice impacts in an EIS and identifies environmental justice populations (i.e., minority and low-income populations) within a 50-mi (80-km) radius of Turkey Point. In this section, the staff describes the potential human health and environmental effects of the proposed action (subsequent license renewal) and alternatives to the proposed action on minority and low-income populations.

4.12.1 Proposed Action

The NRC addresses environmental justice matters for license renewal (including subsequent license renewal) by (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the subsequent license renewal term, (2) determining whether there would be any potential human health or environmental effects to these populations or to special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determining whether any of the effects may be disproportionately high and adverse. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Figure 3-23 and Figure 3-24 show the location of predominantly minority and low-income population block groups residing within a 50-mi (80-km) radius of Turkey Point. This area of impact is consistent with the 50-mi (80-km) impact analysis for public and occupational health and safety. This chapter (Chapter 4) of the SEIS presents the assessment of environmental and human health impacts for each resource area. The analyses of impacts for environmental resource areas indicated that groundwater use conflicts would be SMALL to MODERATE because FPL's continued operation of its Upper Floridan aquifer production wells is likely to affect offsite well systems by increasing drawdown in the aquifer. However, as discussed in Section 4.5.1.2.2 of this SEIS, while projected drawdowns would noticeably affect the Upper Floridan aquifer, FPL's continued withdrawals would not be likely to destabilize the groundwater resource or impair the use by other users and well systems during the subsequent license renewal period. Therefore, these impacts would not be high and adverse. Additionally, the staff's analysis identified SMALL to MODERATE impacts for impingement and entrainment of aquatic organisms and thermal impacts on aquatic organisms in the CCS. As discussed in Section 4.7.1.1, the impacts are unlikely to create effects great enough to destabilize important attributes of the aquatic environment over the course of the subsequent license renewal term because the CCS aquatic community is composed of common species that exhibit no unique ecological value or niche and have no commercial or recreational value. The SMALL to MODERATE finding applies to only those aquatic resources occurring in the CCS, to which the public has no access. Impingement and entrainment and thermal effects do not apply to aquatic organisms inhabiting Biscayne Bay or other natural waterbodies because there are no surface water connections that allow flow between these waters and the CCS. Therefore, the impacts on aquatic resources would not be disproportionately high and adverse.

Potential impacts on minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the subsequent license renewal term are expected to continue at current levels and would remain within regulatory limits. Section 4.11.1.3, "Environmental Consequences of Postulated Accidents," discusses the environmental impacts from severe accidents that might occur during the subsequent license renewal term. The Commission has determined that the probability-weighted consequences of severe accidents are SMALL. Therefore, these impacts would not be high and adverse.

Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice concerns associated with subsequent license renewal, the NRC staff assessed the potential radiological risk to special population groups (such as migrant workers or Native Americans) from exposure to radioactive material received through their unique consumption practices and interactions with the environment, including the subsistence consumption of fish, wildlife, and native vegetation; contact with surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the plant during routine operation. The special pathway receptors analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area. The results of this analysis are presented here.

Section 4-4 of Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629), directs Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. As part of the environmental review pertaining to the proposed new Turkey Point Units 6 and 7, the NRC staff concluded that subsistence activities are typically not conducted by minority or low-income populations in the vicinity of Turkey Point (NRC 2016a). In this SEIS, the NRC staff considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts on American Indians, Hispanics, migrant workers, and other traditional lifestyle special pathway receptors. The assessment of special pathways considered the levels of radiological and non-radiological contaminants in fish, sediments, water, milk, and food products on or near Turkey Point.

Radionuclides released to the atmosphere may deposit on soil and vegetation and may therefore eventually be incorporated into the human food chain. To assess the impact of Turkey Point operations to humans from the ingestion pathway, FPL collects and analyzes samples of air, water, sediment, fish, vegetation, and milk, if available, for radioactivity as part of its ongoing, comprehensive Radiological Environmental Monitoring Program.

To assess the impact of nuclear power plant operations on the environment, FPL collects samples annually from the environment and analyzes the samples for radioactivity. Two types of samples are collected. The first type, a control sample, is collected from areas that are beyond the influence of the nuclear power plant or any other nuclear facility. These control samples are used as reference data to determine normal background levels of radiation in the environment. The second type of samples, indicator samples, are collected near the nuclear power plant from areas where any radioactivity contribution from the nuclear power plant will be at its highest concentration. These indicator samples are then compared to the control samples to evaluate the contribution of nuclear power plant operations to radiation or radioactivity levels in the environment. An effect would be indicated if the radioactivity levels detected in an indicator sample were higher than the control sample or background levels.

FPL collected air samples and samples from the aquatic, and terrestrial environment near Turkey Point in 2017. The aquatic pathways sampled include surface water, shoreline sediment, and fish.

Aquatic monitoring results for 2017 were consistent with previous levels and, except for tritium in surface and groundwater, yielded no indication of nuclides attributable to Turkey Point operation. Tritium was reported in surface and groundwater samples. Tritium concentrations in water samples were below reporting limits as specified by Turkey Point's Offsite Dose Calculation Manual (30,000 pCi/L) and EPA's public drinking water standard (20,000 pCi/L) (FPL 2013a, FPL 2018j, 40 CFR 141.16). Tritium occurs in underlying groundwater beneath the CCS as well as in adjacent areas beneath the Turkey Point plant complex. Because the canals comprising the CCS are not lined, CCS water containing tritium migrates into the groundwater of the underlying Biscayne aquifer. Sections 3.5.2.2 and 4.5.1.2 of this SEIS discuss groundwater tritium levels in the vicinity of the Turkey Point site and Turkey Point's Groundwater Protection Program in greater detail. As stated in Section 4.5.1.2, at no location outside the boundary of the Turkey Point site do tritium levels in groundwater approach the EPA and State primary drinking water standard for tritium (20,000 pCi/L), while the highest tritium levels in offsite monitoring wells near the site were at 15 percent of the standard.

Terrestrial monitoring results for 2017 of broad leaf vegetation were consistent with previous levels. Cesium-137 was detected in samples collected and it was below reporting limits as specified by Turkey Point's Offsite Dose Calculation Manual. Cesium-137 could be associated with fallout from past atmospheric nuclear weapons and reactor accidents (FPL 2018j). Milk samples were not available for testing.

Based on the radiological environmental monitoring data from Turkey Point, special pathway receptor populations in the region are not expected to experience disproportionately high and adverse human health impacts as a result of subsistence consumption of water, local food, fish, and wildlife.

4.12.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed licenses. Impacts on minority and low-income populations would include loss of jobs, reduction in tax revenue, and potentially a reduction in public services. A decrease in the availability of services could disproportionately affect minority and low-income populations that may have become dependent on these services. However, as discussed in Section 4.10.2, "No-Action Alternative," of this SEIS, because of the large population, labor force, and tax revenue of Miami-Dade County, the socioeconomic impacts from not issuing the subsequent renewed licenses and terminating reactor operations at Turkey Point would be SMALL. Therefore, under the no-action alternative, the effects to minority and low-income populations would not be disproportionately high and adverse.

4.12.3 Replacement Power Alternatives: Common Impacts

<u>Construction</u>

Potential impacts to minority and low-income populations from the construction of a new replacement power plant would mostly consist of environmental and socioeconomic effects (e.g., noise, air emissions, traffic, employment, and housing impacts). Figure 3-23 and Figure

3-24 show the location of predominantly minority and low-income population block groups residing within a 50-mi (80-km) radius of Turkey Point. Minority and low-income populations residing along site access roads could be affected by increased truck traffic and increased commuter vehicle traffic, especially during shift changes. However, a 2017 land-use survey within a 5-mi radius of Turkey Point identified few residents in the vicinity of the Turkey Point site; the nearest resident was approximately 2 mi (3.2 km) away from the site and the nearest residential communities are in Homestead, approximately 6.0 mi (9.7 km) west of the site (FPL 2018j). During the environmental site audit, the NRC staff confirmed that there are few residents along site access roads in the immediate vicinity of the Turkey Point site, in particular Palm Drive. Therefore, increased traffic along site access roads is not likely to affect minority and low-income populations.

Noise would result from construction equipment, site activities, and additional traffic. Migrant agricultural workers (see Section 3.10.3.2, "Migrant Farm Workers," of this SEIS) could be particularly vulnerable to noise impacts because of their outdoor presence. However, the nearest farm is approximately 4.5 mi (7.2 km) away from Turkey Point (FPL 2018j); and the NRC staff has determined that noise would be temporary and not significant, and that noise levels would be lessened by distance. Air emissions would result from increased vehicle traffic, construction equipment, and fugitive dust from construction activities. These emissions would be temporary and minor (see Section 4.3.3, "Replacement Power Alternatives: Common Impacts," of this SEIS). Increased demand for rental housing during construction could disproportionately affect low-income populations. However, there is a large housing stock available in Miami-Dade County (see Table 3-20 and Table 3-22).

<u>Operation</u>

Low-income populations living near the power plant that rely on subsistence consumption of fish and wildlife could be disproportionately affected by replacement power alternatives. Emissions during power plant operations could disproportionately affect nearby minority and low-income populations, depending on the type of replacement power. Noise, primarily associated with cooling towers and vehicle traffic, would be intermittent and not noticeable.

4.12.3.1 New Nuclear Alternative

Potential impacts to minority and low-income populations from the construction and operation of the new nuclear alternative on the Turkey Point site would be similar to the impacts discussed above in Section 4.12.3 as common to all replacement power alternatives. While transportation impacts on access roads in the immediate vicinity of Turkey Point during construction of a new nuclear alternative would be LARGE, there are few residents along site access roads in the immediate vicinity of the Turkey Point site and the nearest residential community is in Homestead, approximately 6.0 mi (9.7 km) from the site. Potential impacts from operation would mostly consist of radionuclide releases and effects during operations; however, radiation doses would be required to meet regulatory limits, similar to the current operation of Turkey Point.

Based on (1) the location of the new nuclear alternative, (2) the assumed plant design and characteristics, and (3) the human health and environmental effects findings, construction and operation of the new nuclear alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.3.2 Natural Gas Combined-Cycle Alternative

Potential impacts to minority and low-income populations from the construction and operation of the natural gas alternative on the Turkey Point site would be similar to the impacts discussed above in Section 4.12.3 as common to all replacement power alternatives. While transportation impacts on access roads in the immediate vicinity of Turkey Point during construction of a natural gas alternative would be MODERATE, there are few residents along site access roads in the vicinity of the Turkey Point site and the nearest residential community is in Homestead, approximately 6.0 mi (9.7 km) from the site. As noted in Section 3.12, "Environmental Justice," of this SEIS and in Figure 3-23 and Figure 3-24, the Turkey Point site is in a minority and low-income population block group where the minority population exceeds 78 percent. As discussed in Section 4.3.5, "Natural Gas Combined-Cycle," of this SEIS, nitrogen oxide and greenhouse gas emissions from a natural gas combined-cycle plant would be significant. Therefore, there would be a high concentration of minorities in close proximity to the source of air emissions. However, as discussed in Section 4.3.5, "Natural Gas Combined-Cycle," of this SEIS, emissions would be noticeable but not destabilizing. Therefore, these effects are not likely to be high and adverse and emissions from the natural gas alternative during power plant operation are not likely to disproportionately affect minority populations living in the vicinity of the new power plant.

Based on (1) the location of the natural gas alternative, (2) the assumed plant design and characteristics, and (3) the human health and environmental effects findings, construction and operation of the natural gas alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.3.3 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic)

Potential impacts to minority and low-income populations from the construction and operation of the natural gas portion of the combination alternative on the Turkey Point site would be the same as those discussed for the natural gas alternative (see Section 4.12.3.2 of this SEIS). Therefore, the construction and operation of the natural gas portion would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

Potential impacts to minority and low-income populations from the construction and operation of solar facilities would mostly consist of environmental and socioeconomic effects (e.g., noise, air emissions, traffic, employment, and housing impacts). Figure 3-23 and Figure 3-24 show the location of predominantly minority and low-income population block groups residing within a 50-mi (80-km) radius of Turkey Point. Three of the solar facilities would be built in Miami-Dade and/or Broward County. According to the 2010 U.S. Census, minorities comprised 56.5 percent of the total Broward County population (USCB 2010c). The 2012–2016 American Survey Community 5-Year Estimates shows that 14.4 percent of individuals in Broward County live below the poverty threshold (USCB 2018). As noted in Chapter 3, minorities comprised approximately 86 percent of the total Miami-Dade County population and 18.3 percent of individuals in Miami-Dade County live below the poverty threshold.

Noise and air emissions impacts from construction would be short term and primarily limited to onsite activities. Increased demand for rental housing during construction and operations could affect low-income populations. However, given the number of construction workers and housing availability in Miami-Dade and Broward Counties, the potential need for rental housing would not be significant. During operations, there would not be a noticeable housing demand given the small number of workers needed to maintain and operate the solar facilities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. Transportation impacts would be SMALL to MODERATE and would depend on the location of the solar facilities in Broward County. However, these effects would be temporary during certain hours of the day.

Based on this information and the analysis of human health and environmental impacts presented in this SEIS, it is not likely that the construction and operation of the solar facilities would have disproportionately high and adverse human health and environmental effects on minority and low-income populations. However, this determination would depend on the location of the facilities in Miami-Dade County and/or Broward County. Therefore, the NRC staff cannot determine whether the solar portion of the combination alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.4 Cooling Water System Alternative

Potential impacts to minority and low-income populations from the construction and operation of the cooling water system alternative would mostly consist of environmental and socioeconomic effects (e.g., noise, air emissions, traffic, employment, and housing impacts). Figure 3-23 and Figure 3-24 show the location of predominantly minority and low-income population block groups residing within a 50-mi (80-km) radius of Turkey Point. As discussed in Section 4.10.7, “Cooling Water System Alternative,” of this SEIS, transportation impacts during construction would be SMALL to MODERATE on roads in the immediate vicinity of Turkey Point. Minority and low-income populations residing along site access roads could be affected by increased truck traffic and increased commuter vehicle traffic, especially during shift changes. However, the transportation impacts would be on access roads in the immediate vicinity of Turkey Point. A 2017 land-use survey within a 5-mi (8.0 km) radius of Turkey Point identified few residents in the vicinity of the Turkey Point site; the nearest resident was approximately 2 mi (3.2 km) away from the site and the nearest residential communities are in Homestead, approximately 6.0 mi (9.7 km) west of the site (FPL 2018j). During the environmental site audit, the NRC staff confirmed that there are few residents along site access roads in the immediate vicinity of the Turkey Point site, in particular Palm Drive.

Noise would result from construction equipment, site activities, and additional traffic. Migrant agricultural workers (see Section 3.10.3.2, “Migrant Farm Workers,” of this SEIS) could be particularly vulnerable to noise impacts because of their outdoor presence. However, the nearest farm is approximately 4.5 mi (7.2 km) away from Turkey Point (FPL 2018j); and the NRC staff has determined that noise would be temporary, not significant, and that noise levels would be lessened by distance. Air emissions would result from increased vehicle traffic, construction equipment, and fugitive dust from construction activities. However, these emissions would be temporary and minor (see Section 4.3.4, “New Nuclear Alternative,” of this SEIS).

Replacement power will be required during the construction outage as well as a result of efficiency losses or additional power needed to operate cooling tower pumps and fans once the cooling system is online. Replacement power could increase air quality impacts and human health effects in minority and low-income communities, depending on the location and characteristics of replacement power used to replace Turkey Point power. The effects would be short lived during the construction-related outages and would occur near the existing power plants and would result from incremental increases rather than new effects. As discussed in

Section 4.12.4 of this SEIS, during operations, the cooling towers would emit particulate matter, however, these emissions would be minor.

Based on the analysis of human health and environmental impacts presented in this SEIS, the location of the alternative, and the assumed alternative design and characteristics, this alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.13 Waste Management

This section describes the potential waste management impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.13.1 Proposed Action

According to the GEIS (NRC 1996, NRC 2013a), the generic issues related to waste management as identified in Table 4-1 would not be affected by continued operations associated with license renewal. As discussed in Chapter 3, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of the generic issues related to waste management would be SMALL.

Table 4-2 does not identify any Turkey Point site-specific (Category 2) waste management issues resulting from issuing a subsequent renewed license for an additional 20 years of operations.

4.13.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point would shut down on or before the expiration of the current renewed licenses and enter decommissioning. After entering decommissioning, the plant would generate less spent nuclear fuel, emit less gaseous and liquid radioactive effluents into the environment, and generate less low-level radioactive and nonradioactive wastes. In addition, following shutdown, the variety of potential accidents at the plant (radiological and industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. Therefore, as radioactive emissions to the environment decrease, and the likelihood and variety of accidents decrease following shutdown and decommissioning, the NRC staff concludes that the impacts resulting from waste management from the implementation of the no-action alternative would be SMALL.

4.13.3 Replacement Power Alternatives: Common Impacts

Impacts from waste management common to all analyzed replacement power alternatives would be from construction-related debris generated during construction activities, and this waste would be recycled or disposed of in approved landfills.

4.13.4 New Nuclear Alternative

Impacts from the waste generated during the construction of a new nuclear unit would include those identified in Section 4.13.3, as common to all replacement power alternatives.

During normal plant operations, routine plant maintenance and cleaning activities would generate radioactive low-level waste, spent nuclear fuel, high-level waste, and nonradioactive waste. Sections 3.1.4 and 3.1.5 of this SEIS discuss radioactive and nonradioactive waste management at Turkey Point. Quantities of radioactive and nonradioactive waste generated by Turkey Point would be comparable to that generated by the new nuclear plant. As stated in the GEIS (NUREG-1437) (NRC 2013a), the NRC does not expect the generation and management of solid radioactive and nonradioactive waste during the subsequent license renewal term to result in significant environmental impacts. Based on this information, the waste impacts would be SMALL for the new nuclear alternative.

4.13.5 Natural Gas Combined-Cycle Alternative

Impacts from the waste generated during the construction of a natural gas power plant would include those identified in Section 4.13.3 of this SEIS as common to all replacement power alternatives.

Waste generation from natural gas technology would be minimal. The only significant waste generated at a natural gas combined-cycle power plant would be spent selective catalytic reduction catalyst (plants use selective catalytic reduction catalyst to control nitrogen oxide emissions).

The spent catalyst would be regenerated or disposed of offsite. Other than the spent selective catalytic reduction catalyst, waste generation at an operating natural gas fired plant would be limited largely to typical operations and maintenance nonhazardous waste (NRC 2013a). Overall, the NRC staff concludes that waste impacts from the natural gas alternative would be SMALL.

4.13.6 Combination Alternative (Natural Gas Combined-Cycle and Solar Photovoltaic Generation)

Impacts from the waste generated during the construction of the natural gas combined-cycle (NGCC) plant and solar photovoltaic (PV) alternative would include those identified in Section 4.13.3 of this SEIS as common to the construction of all replacement power alternatives. The combination alternative consists of a natural gas plant and solar PV facilities that provide generation equivalent to Turkey Point's 1,632 MWe with an annual generation of approximately 13,154,016 MWhs. The natural gas plant would be located at the Turkey Point site. Four solar PV facilities would be constructed. One solar PV facility would be located on FPL-owned land on or near the Turkey Point site, and the other three solar facilities would be located in Miami-Dade or Broward County.

During the construction of the natural gas plant and solar PV facilities, land clearing and other construction activities would generate waste that could be recycled, disposed of onsite, or shipped to an offsite waste disposal facility.

Waste generation from natural gas technology would be minimal. The only significant waste generated at a natural gas combined-cycle power plant would be spent selective catalytic reduction catalyst (plants use selective catalytic reduction catalyst to control nitrogen oxide emissions).

The spent catalyst would be regenerated or disposed of offsite. Other than the spent selective catalytic reduction catalyst, waste generation at an operating natural gas fired plant would be limited largely to typical operations and maintenance nonhazardous waste (NRC 2013a). Overall, the NRC staff concludes that waste impacts from the natural gas portion of the combination alternative would be SMALL.

Impacts on waste management from the construction and operation of the natural gas plant and pipeline component of the combination alternative would be similar to those associated with the natural gas alternative.

The construction of the solar PV facilities would create sanitary and industrial waste, although it would be of smaller quantity as compared to the natural gas plant. This waste could be recycled, disposed of onsite, or shipped to an offsite waste disposal facility. All of the waste would be handled in accordance with appropriate Florida Department of Environmental Protection regulations. Impacts on waste management resulting from the construction and operation of the solar PV facilities of the combination alternative would be minimal, and of a smaller quantity as compared to the natural gas plant. In sum, the waste management impacts resulting from the construction and operation of the PV facilities would be SMALL.

Overall, the NRC staff concludes that waste impacts for the natural gas and solar PV combination alternative would be SMALL.

4.13.7 Cooling Water System Alternative

Waste management impacts from the waste generated during the construction of the cooling water system alternative would include those identified in Section 4.13.3 as common to all replacement power alternatives.

During operation, some minor amounts of chemical wastes may result from efforts to maintain appropriate chemical quality of the recirculating cooling water, from the periodic maintenance (i.e., descaling) of the cooling towers, and from periodic removal of settled precipitates from the cooling water basins beneath each cooling tower. Operational solid wastes are expected to be temporarily stored on site or ultimately treated, recycled, or disposed in appropriately permitted offsite facilities. FPL would be expected to implement appropriate waste management practices to minimize volume and content of waste generated from the construction and operation of the cooling towers. Any cooling water treatment and conditioning chemical residuals (e.g., biocides, corrosion inhibitors) necessary for proper operation, maintenance, and microorganism control of the cooling towers and Turkey Point circulating water system would be disposed of and managed in accordance with FDEP requirements.

In consideration of the information and assumptions presented above, the NRC staff concludes that the impacts from waste management from the construction and operation of the cooling water system alternative would be SMALL.

4.14 <u>Evaluation of New and Significant Information</u>

As stated in Section 4.1, “Introduction,” of this SEIS, for Category 1 (generic) issues, the NRC staff can rely on the analysis in the GEIS (NUREG-1437) (NRC 2013a) unless otherwise noted. Table 4-1 lists the Category 1 issues that apply to Turkey Point during the proposed subsequent license renewal period. The NRC staff identified and evaluated new and potentially significant information for two existing Category 1 issues (i.e., groundwater quality degradation (plants with cooling ponds in salt marshes) and cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)) and identified one new uncategorized issue (i.e., water quality impacts on adjacent water bodies (plants with cooling ponds in salt marshes)). The NRC staff determined that the information was both new and significant for one of the issues, “Groundwater quality degradation (plants with cooling ponds in salt marshes),” as listed in Table 4-1 and as evaluated in Section 4.5.1.2, “Groundwater Resources,” of this SEIS. For all other issues, the NRC staff did not identify any new and significant information during its review of FPL’s environmental report, the site audits, or the scoping period that would change the conclusions presented in the GEIS.

New and significant information must be new based on a review of the GEIS (NRC 2013a) as codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51. Such information must also bear on the proposed action or its impacts, presenting a seriously different picture of the impacts from those envisioned in the GEIS (i.e., impacts of greater severity than the impacts considered in the GEIS, considering their intensity and context).

The NRC defines new and significant information in Regulatory Guide (RG) 4.2, Supplement 1, “Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications” (NRC 2013b), as (1) information that identifies a significant environmental impact issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, in Appendix B to Subpart A of 10 CFR Part 51, or (2) information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1. Further, a significant environmental issue includes, but is not limited to, any new activity or aspect associated with the nuclear power plant that can act upon the environment in a manner or an intensity and/or scope (context) not previously recognized.

In accordance with 10 CFR 51.53(c), “Operating license renewal stage,” the applicant’s environmental report must analyze the Category 2 (site-specific) issues in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51. Additionally, the applicant’s environmental report must discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action. In accordance with 10 CFR 51.53(c), the applicant’s environmental report does not need to analyze any Category 1 issue unless there is new and significant information on a specific issue.

NUREG–1555, Supplement 1, Revision 1, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants for Operating License Renewal” describes the NRC process for identifying new and significant information (NRC 2013b). The search for new information includes:

- review of an applicant’s environmental report (FPL 2018f, FPL 2018n) and the process for discovering and evaluating the significance of new information
- review of public comments
- review of environmental quality standards and regulations
- coordination with Federal, State, and local environmental protection and resource agencies
- review of technical literature as documented through this SEIS

New information is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues for which new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to an assessment of the relevant new and significant information; the scope of the assessment does not include other facets of an issue that the new information does not affect.

The NRC staff reviewed the discussion of environmental impacts associated with operation during the subsequent license renewal term in the GEIS and has conducted its own independent review, including a public involvement process (e.g., public meetings and comments) to identify new and significant issues for the Turkey Point subsequent license renewal application environmental review.

4.15 Impacts Common to All Alternatives

This section describes the impacts that the NRC staff considers common to all alternatives discussed in this SEIS, including the proposed action and replacement power alternatives. The continued operation of a nuclear power plant and replacement fossil fuel power plants both involve mining, processing, and the consumption of fuel that result in comparative impacts (NRC 2013a). In addition, the following sections discuss the termination of operations and the decommissioning of both a nuclear power plant and replacement fossil fuel power plants and greenhouse gas emissions.

4.15.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of both the proposed action and all replacement power alternatives. Most replacement power alternatives employ a set of steps in the use of their fuel sources, which can include extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle (NRC 2013a).

4.15.1.1 Uranium Fuel Cycle

The uranium fuel cycle includes uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level wastes and high-level wastes related to uranium fuel cycle activities. The GEIS (NUREG-1437) describes in detail the generic potential impacts of the radiological and non-radiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes (NRC 1996, NRC 1999, NRC 2013a). The GEIS does not identify any site-specific (Category 2) uranium fuel cycle issues.

As stated in the GEIS (NRC 1996, NRC 2013a), the generic issues related to the uranium fuel cycle as identified in Table 4-1 would not be affected by continued operations associated with license renewal. As discussed in Chapter 3, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of generic issues related to the uranium fuel cycle would be SMALL.

4.15.1.2 Replacement Power Plant Fuel Cycles

Fossil Fuel Energy Alternatives

Fuel cycle impacts for a fossil fuel-fired plant result from the initial extraction of fuel, cleaning and processing of fuel, transport of fuel to the facility, and management and ultimate disposal of solid wastes from fuel combustion. These impacts are discussed in more detail in

Section 4.12.1.2 of the GEIS (NUREG-1437) (NRC 2013a) and can generally include the following:

- significant changes to land use and visual resources
- impacts to air quality, including release of criteria pollutants, fugitive dust, volatile organic compounds, and coalbed methane into the atmosphere
- noise impacts
- geology and soil impacts due to land disturbances and mining
- water resource impacts, including degradation of surface water and groundwater quality
- ecological impacts, including loss of habitat and wildlife disturbances
- historic and cultural resources impacts within the mine or pipeline footprint
- socioeconomic impacts from employment of both the mining workforce and service and support industries
- environmental justice impacts
- health impacts to workers from exposure to airborne dust and methane gases
- generation of industrial wastes

<u>New Nuclear Energy Alternatives</u>

Uranium fuel cycle impacts for a nuclear plant result from the initial extraction of fuel, transport of fuel to the facility, and management and ultimate disposal of spent fuel. The environmental impacts of the uranium fuel cycle are discussed in Section 4.15.1.1 of this SEIS.

<u>Renewable Energy Alternatives</u>

The fuel cycle for renewable energy facilities is difficult to define for different technologies because these natural resources exist regardless of any effort to harvest them for electricity production. Impacts from the presence or absence of these renewable energy technologies are often difficult to determine (NRC 2013a).

4.15.2 Terminating Power Plant Operations and Decommissioning

This section describes the environmental impacts associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations. For the proposed action at Turkey Point, subsequent license renewal would delay this eventuality for an additional 20 years beyond the current license period, which ends in 2032 (Unit 3) and 2033 (Unit 4).

4.15.2.1 Existing Nuclear Power Plant

Decommissioning would occur whether Turkey Point is shut down at the end of its current renewed license or at the end of the subsequent license renewal term. NUREG–0586, Supplement 1, “Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors” (the Decommissioning GEIS), evaluates the environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license (NRC 2002). Additionally, the License Renewal GEIS (NUREG-1437) (NRC 2013a) discusses the incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term. As noted in Table 4-1, there is one Category 1 issue applicable to Turkey Point decommissioning following the subsequent license renewal term. The License Renewal GEIS did not identify any site-specific (Category 2) decommissioning issues.

4.15.2.2 Replacement Power Plants

Fossil Fuel Energy Alternatives

The environmental impacts from the termination of power plant operations and decommissioning of a fossil fuel-fired plant are dependent on the facility's decommissioning plan. General elements and requirements for a fossil fuel plant decommissioning plan are discussed in Section 4.12.2.2 of the License Renewal GEIS (NUREG-1437) and can include the removal of structures to at least 3 feet (1 m) below grade; removal of all coal, combustion waste, and accumulated sludge; removal of intake and discharge structures; and the cleanup and remediation of incidental spills and leaks at the facility. The decommissioning plan outlines the actions necessary to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013a).

The environmental consequences of decommissioning are discussed in Section 4.12.2.2 of the License Renewal GEIS (NUREG-1437) and can generally include the following:

- short-term impacts on air quality and noise from the deconstruction of facility structures
- short-term impacts on land use and visual resources
- long-term reestablishment of vegetation and wildlife communities
- socioeconomic impacts due to decommissioning the workforce and the long-term loss of jobs
- elimination of health and safety impacts on operating personnel and the general public

New Nuclear Alternatives

Termination of operations and decommissioning impacts for a nuclear plant include all activities related to the safe removal of the facility from service and the reduction of residual radioactivity to a level that permits release of the property under restricted conditions or unrestricted use and termination of a license (NRC 2013a). The environmental impacts of the uranium fuel cycle are discussed in Section 4.15.1.1, "Uranium Fuel Cycle."

Renewable Alternatives

Termination of power plant operation and decommissioning for renewable energy facilities would be similar to the impacts discussed for fossil fuel-fired plants. Decommissioning would involve the removal of facility components and operational wastes and residues to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013a).

4.15.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss greenhouse gas emissions and climate change impacts. Section 4.15.3.1 evaluates greenhouse gas emissions associated with operation of Turkey Point Units 3 and 4 and replacement power alternatives. Section 4.15.3.2 discusses the observed changes in climate and the potential future climate change during the subsequent license renewal term based on climate model simulations under future global greenhouse gas emission scenarios. The cumulative impacts of global greenhouse gas emissions on climate are discussed in Section 4.16.10, "Global Greenhouse Gas Emissions," in this SEIS. In Section 4.16, "Cumulative Impacts," of this SEIS, the NRC staff considers the potential cumulative, or overlapping, impacts from climate change on environmental resources where there are incremental impacts of the proposed action (subsequent license renewal).

4.15.3.1 Greenhouse Gas Emissions from the Proposed Action and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed greenhouse gases. Greenhouse gases include carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); water vapor (H_2O); and fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The Earth's climate responds to changes in concentrations of greenhouse gases in the atmosphere because these gases affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing greenhouse gas concentrations in the atmosphere generally increase the Earth's surface temperature. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have significantly increased since 1750 (IPCC 2007, IPCC 2013). Carbon dioxide, methane, nitrous oxide, water vapor, and fluorinated gases (termed long-lived greenhouse gases) are well mixed throughout the Earth's atmosphere, and their impact on climate is long lasting as a result of their long atmospheric lifetime (EPA 2009b). Carbon dioxide is of primary concern for global climate change, due to its long atmospheric lifetime, and it is the primary gas emitted as a result of human activities. Climate change research indicates that the cause of the Earth's warming over the last 50 years is due to the buildup of greenhouse gases in the atmosphere resulting from human activities (IPCC 2013, USGCRP 2014, USGCRP 2017). The EPA has determined that greenhouse gases "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496).

<u>Proposed Action</u>

Operation of Turkey Point emits greenhouse gases directly and indirectly. Turkey Point's direct greenhouse gas emissions result from stationary portable combustion sources (see Table 3-2) and stationary refrigeration appliances. Indirect greenhouse gas emissions originate from mobile combustion sources (e.g., employee vehicles, visitor vehicles, and delivery vehicles). Table 4-6 below presents quantified annual greenhouse gas emissions from sources at Turkey Point.

FPL does not maintain an inventory of greenhouse gas emissions resulting from visitor and delivery vehicles. Chlorofluorocarbon and hydrochlorofluorocarbon emissions from refrigerant sources can result from leakage, servicing, repair, or disposal of refrigerant sources. Chlorofluorocarbons and hydrochlorofluorocarbons are ozone-depleting substances that are regulated by the Clean Air Act under Title VI, "Stratospheric Ozone Protection." FPL maintains a program to manage stationary refrigeration appliances at Turkey Point to recycle, recapture, and reduce emissions of ozone-depleting substances (FPL 2018f). Estimating greenhouse gas emissions from refrigerant sources is complicated due to their ability to deplete ozone, which is also a greenhouse gas, making their global warming potentials difficult to quantify. Consequently, greenhouse gas emissions from refrigerant sources are commonly excluded from greenhouse gas inventories (EPA 2014d). Therefore, Table 4-6 does not account for potential greenhouse gas emissions from stationary refrigeration appliances or visitor and delivery vehicles at Turkey Point.

Table 4-6 Estimated Greenhouse Gas Emissions[a] from Operation at Turkey Point, Units 3 and 4

Year	Turkey Point Combustion Sources[b] (tons/year)	Workforce Commuting[c] (tons/year)	Total (tons/year)
2012	520	3,100	3,620
2013	450	3,100	3,550
2014	560	3,100	3,660
2015	710	3,100	3,810
2016	490	3,100	3,590

[a] Emissions are rounded up.

[b] Includes stationary and portable diesel and gasoline engines described in Table 3-2.

[c] Emissions consider Turkey Point full-time employees and does not include additional contractor workers during refueling outages. Refueling outages occur on a staggered, 18-month schedule and last approximately 25–35 days per unit.

Sources: FPL 2018f

No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Turkey Point Units 3 and 4 would shut down on or before the expiration of the current renewed licenses. At some point, all nuclear plants will terminate operations and undergo decommissioning. The Decommissioning GEIS (NUREG–0586, NRC 2002a) considers the impacts from decommissioning. Therefore, the scope of impacts considered under the no-action alternative includes the immediate impacts resulting from activities at Turkey Point that would occur between plant shutdown and the beginning of decommissioning (i.e., activities and actions necessary to cease operation of Turkey Point). Turkey Point operations would terminate at or before the expiration of the current renewed licenses. When the plant stops operating, a reduction in greenhouse gas emissions from activities related to plant operation, such as the use of diesel generators and employee vehicles, would occur. The NRC staff anticipates that greenhouse gas emissions for the no-action alternative would be less than those presented in Table 4-6, which shows the estimated greenhouse gas emissions from operation of Turkey Point Units 3 and 4.

Since the no-action alternative would result in a loss of power generating capacity due to shutdown, the sections below discuss greenhouse gas emissions associated with replacement baseload power generation for each replacement power alternative analyzed.

New Nuclear Alternative

The GEIS (NUREG-1437) presents life-cycle greenhouse gas emissions associated with nuclear power generation. As presented in Tables 4.12-4 through 4.12-6 of the GEIS (NRC 2013a), life-cycle greenhouse gas emissions from nuclear power generation can range from 1 to 288 grams carbon equivalent per kilowatt-hour (g C_{eq}/kWh). Nuclear power plants do not burn fossil fuels to generate electricity. Sources of greenhouse gas emissions from the new nuclear alternative would include stationary combustion sources such as emergency diesel generators, boilers, and pumps similar to existing sources at Turkey Point (see Section 3.2.1 of this SEIS). The NRC staff estimates that greenhouse gas emissions from a new nuclear alternative would be similar to greenhouse gas emissions from Turkey Point.

Natural Gas Combined-Cycle Alternative

The GEIS (NRC 2013a) presents life-cycle greenhouse gas emissions associated with natural gas power generation. As presented in Table 4.12-5 of the GEIS, life-cycle greenhouse gas emissions from natural gas can range from 120 to 930 g C_{eq}/kWh. The NRC staff estimates that direct emissions from the operation of three, 500-MWe natural gas combined-cycle units would total 5.7 million tons (5.2 million MT) of carbon dioxide equivalents (CO_{2eq}) per year.

Combination Alternative

For the combination alternative, greenhouse gases would primarily be emitted from the natural gas component of this alternative. The NRC staff estimates that the operation of the natural gas-fired units would emit a total of 5.4 million tons (4.9 million MT) of CO_{2eq} per year.

Summary of Greenhouse Gas Emissions from the Proposed Action and Alternatives

Table 4-7 below presents the direct greenhouse gas emissions from facility operations under the proposed action of subsequent license renewal and alternatives to the proposed action. Greenhouse gas emissions from the proposed action (subsequent license renewal), the no-action alternative, and the new nuclear alternative would be the lowest. Greenhouse gas emissions from the natural gas and combination alternatives are several orders of magnitude greater than those from the continued operation of Turkey Point. Therefore, if Turkey Point's generating capacity were to be replaced by either of these two alternatives, there would be an increase in greenhouse gas emissions. Consequently, the continued operation of Turkey Point (the proposed action) results in greenhouse gas emissions avoidance as compared to the natural gas or combination alternative.

Table 4-7 Direct Greenhouse Gas Emissions from Facility Operations Under the Proposed Action and Alternatives

Technology/Alternative	CO_{2eq}[(a)] (tons/year)
Proposed Action (Turkey Point subsequent license renewal)[(b)]	710
No-Action Alternative[(c)]	710
New Nuclear[(d)]	710
Natural Gas Combined-Cycle[(e)]	5.7×10^6
Combination Alternative[(f)]	5.4×10^6

Technology/Alternative	CO_{2eq}[(a)] (tons/year)
[(a)] Carbon dioxide equivalent (CO_{2eq}) is a metric used to compare the emissions of greenhouse gases (GHG) based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_{2eq} is obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of methane is 21; therefore, 1 ton of methane emission is equivalent to 21 tons of carbon dioxide emissions.	
[(b)] Greenhouse gas emissions include only direct emissions from combustion sources for the peak year presented in Table 4-6 (Source: FPL 2018f).	
[(c)] Emissions resulting from activities at Turkey Point that would occur between plant shutdown and the beginning of decommissioning and assumed not to be greater than greenhouse gas emissions from operation of Turkey Point.	
[(d)] Emissions assumed to be similar to Turkey Point operation.	
[(e)] Emissions from direct combustion of natural gas. Greenhouse gas emissions estimated using emission factors developed by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL 2010).	
[(f)] Emissions from the natural gas combined-cycle component of the combination alternative. Greenhouse gas emissions estimated using emission factors developed by DOE's National Renewable Energy Laboratory (NETL 2010).	

4.15.3.2 Climate Change

Observed Trends in Climate Change Indicators

Climate change is the decades or longer change in climate measurements (e.g., temperature and precipitation) that has been observed on a global, national, and regional level (IPCC 2007, EPA 2016b, USGCRP 2014). Climate change can vary regionally, spatially, and seasonally, depending on local, regional, and global factors. Just as regional climate differs throughout the world, the impacts of climate change can vary among locations.

On a global level, from 1901 to 2015, average surface temperatures rose at a rate of 0.15 ˚F (0.08 ˚C) per decade, and total annual precipitation increased at an average rate of 0.08 inches (0.2 cm) per decade (EPA 2016b). The year 2017 was the second warmest on record globally, second only to 2016. This finding is based on average global temperature data dating back to 1880. Analyses performed by both NASA and NOAA show that globally, the 5 warmest years on record all have taken place since 2010 (NASA 2018). The observed global change in average surface temperature and precipitation has been accompanied by an increase in sea surface temperatures, a decrease in global glacier ice, an increase in sea level, and changes in extreme weather events. Such extreme events include an increase in the frequency of heat waves, heavy precipitation, and recorded maximum daily high temperatures (IPCC 2007, EPA 2016b, USGCRP 2009, USGCRP 2014).

The U.S. Global Change Research Program (USGCRP) compiles the best available information and current state of knowledge regarding climate change trends and effects at the regional and national level. The USGCRP reports that, from 1895 to 2016, average surface temperature increased by 1.8 °F (1.0 °C) across the contiguous United States and, since 1901, average annual precipitation has increased by 4 percent (USGCRP 2017). On a seasonal basis, warming has been the greatest in winter. Since the 1980s, NOAA data show an increase in the length of the frost-free season, the period between the last occurrence of 32 ˚F (0 °C) in the spring and first occurrence of 32 ˚F (0 °C) in the fall, across the contiguous United States. Over the period 1991 through 2011, the average frost-free season was 10 days longer than between 1901 and 1960 (USGCRP 2014). Observed climate-related changes in the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of sea level in coastal areas, increase in occurrence of heat waves, and a decrease in occurrence of cold waves. Since the 1980s, the intensity, frequency, and duration of North Atlantic hurricanes has increased; however, there is no trend in landfall frequency along the U.S. eastern and Gulf coasts (USGCRP 2014).

Temperature data indicate that the Southeast region of the United States, where Turkey Point is located, did not experience significant warming overall for the time period from 1901 to 2012. In the Southeast region, warming has averaged less than 1 °F (0.56 °C). The overall lack of warming in the Southeast has been termed "the warming hole" (NOAA 2013b). A notable exception is the South Florida region where average temperatures have warmed by greater than 1.5 °F (0.83 °C) (EPA 2016c, USGCRP 2014: Fig 2.7). Annual and seasonal temperatures across the Southeast have exhibited variability during the 20th century. However, since 1970, average annual temperatures have steadily increased and have been accompanied by an increase in the number of days with maximum temperatures above 90 °F (32.2 °C) in the daytime and above 75 °F (23.9 °C) in the nighttime (IPCC 2007, NOAA 2013a, USGCRP 2009, USGCRP 2014). Average annual precipitation data for the Southeast does not exhibit an increasing or decreasing trend for the long-term period (1895–2011) (NOAA 2013b). Precipitation in the Southeast region varies considerably throughout the seasons and average precipitation has generally increased in the fall and decreased in the summer (NOAA 2013b, USGCRP 2009).

Specific to South Florida, the NRC staff used the National Oceanic and Atmospheric Administration's (NOAA) Climate at a Glance tool to analyze temperature and precipitation trends for the period of 1895 to 2018 in the lower east coast region of Florida (NOAA 2018b). A trends analysis shows that average annual temperature has increased at a rate of 0.2 °F (0.11 °C) per decade while average annual precipitation has remained relatively flat with large year-to-year variations (NOAA 2018b). The number of extreme precipitation events (defined as precipitation greater than 4 inches, averaged over 5-year periods) since 1900 has been highly variable for Florida with no clear trend. In contrast, the threat of drought is persistent across the State, and Florida has experienced below average precipitation over the last decade (2005–2014) (Runkle et al. 2017).

Based on an analysis of tidal gauge data, global mean sea level has risen by approximately 8 to 9 inches (20 to 23 cm) since 1880, with about 3 inches (7.6 cm) of the rise having occurred since 1993. Since the early 1990s, tidal gauge and satellite altimeter data indicate an acceleration in the rate of sea level rise, which is now on the order of 1.2 inches (3 cm) per decade. With higher sea levels, the frequency of tidal flooding that causes minor impacts or "nuisance floods" has increased by a factor of 5 to 10 since the 1960s in several United States coastal cities. The rates of increase in such flooding are accelerating in more than 25 cities along the Atlantic and Gulf Coasts (USGCRP 2017).

Observed changes in sea level and their effects vary regionally and locally. In the United States, the Mid-Atlantic and parts of the Gulf coasts have experienced the greatest sea level rise, with some stations having experienced increases of more than 8 in. (20 cm) between 1960 and 2015 (EPA 2016b). Currently, the relative sea level rise trend at Miami, FL is 0.09 in. per year (0.24 cm per year), or about 9 in. (23 cm) per century. This is based on NOAA tidal gauge readings and takes into account local vertical land motion (e.g., subsidence and/or uplift) (NOAA 2018c).

Climate Change Projections

Future global greenhouse gas emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate models indicate that over the next few decades, temperature increases will continue due to current greenhouse gas emission concentrations in the atmosphere (USGCRP 2014). Over the longer term, the magnitude of temperature increases and climate change effects will depend on both past and future global greenhouse gas emissions (IPCC 2007, IPCC 2013, USGCRP 2009, USGCRP 2014). Climate model simulations often use greenhouse gas emission scenarios to represent possible future social, economic, technological, and demographic development that, in turn, drive future emissions. Consequently, the greenhouse gas emission scenarios, their supporting assumptions, and the projections of possible climate change effects entail substantial uncertainty.

The Intergovernmental Panel on Climate Change (IPCC) has generated various representative concentration pathway (RCP) scenarios commonly used by climate-modeling groups to project future climate conditions (IPCC 2000, IPCC 2013, USGCRP 2017, USGCRP 2018). For instance, the A2 scenario is representative of a high-emission scenario in which greenhouse gas emissions continue to rise during the 21st century from 40 gigatons (GT) of carbon dioxide equivalents (CO_{2eq}) per year in 2000 to 140 GT of CO_{2eq} per year by 2100. The B1 scenario, on the other hand, is representative of a low-emission scenario in which emissions rise from 40 GT of CO_{2eq} per year in 2000 to 50 GT of CO_{2eq} per year midcentury before falling to 30 GT of CO_{2eq} per year by 2100 (IPCC 2000, USGCRP 2014).

The RCP scenarios are based on predicted changes in radiative forcing (a measure of the influence that a factor, such as greenhouse gas emissions, has in changing the global balance of incoming and outgoing energy) in the year 2100 relative to preindustrial conditions. The RCPs are numbered in accordance with the change in radiative forcing measured in watts per square meter (i.e., +2.6 (very low), +4.5 (lower), +6.0 (mid-high) and +8.5 (higher)) (USGCRP 2014, 2017, 2018). For example, RCP 8.5 reflects a continued increase in global emissions resulting in increased warming by 2100, while RCP 2.6 assumes immediate and rapid reductions in emissions resulting in less warming by 2100 (USGCRP 2014). Most recently, the USGCRP has used the RCPs and associated modelling results as the basis of its climate change assessments (USGCRP 2017, 2018).

The NRC staff considered the best available national climate change studies as part of its assessment of potential changes in climate-relevant indicators during the Turkey Point subsequent license renewal term (2032–2052 and 2033–2053 for Units 3 and 4, respectively). As input to the Third National Climate Assessment report (USGCRP 2014), NOAA analyzed future regional climate change scenarios based on climate model simulations using the high (A2) and low (B1) emission scenarios. NOAA's climate model simulations (for the period between 2041 and 2070 (2055 midpoint) relative to the reference period, 1971–1999) indicate the following: Annual mean temperature is projected to increase by 1.5–3.5 °F (0.83–1.9 °C) across the Southeast region, including southern Florida, under both a low- and high-emission-modeled scenario (NOAA 2013b). Increases in temperature during this time period are projected to occur for all seasons with the largest increase occurring in the summertime (June, July, and August). Newer regional projections for annual mean temperature are available from The Fourth National Climate Assessment under the RCP 4.5 and RCP 8.5

scenarios for the mid-century (2036-2065) as compared to the average for 1976-2005 (USGCRP 2017). The modeling predicts increases of 3.4–4.3 °F (1.9–2.4 °C) across the Southeast region by mid-century.

As for precipitation, the climate model simulations (for the time period 2021–2050) suggest spatial differences in annual mean precipitation change across the Southeast with some areas experiencing an increase and others a decrease in precipitation. On a seasonal basis, climate models are not in agreement on the sign or direction (increase or decrease) of modeled precipitation changes. For Florida, a 0 to 3 percent decrease in annual mean precipitation is predicted under both a low- and high-emission-modeled scenario; however, the predicted changes in precipitation are not significant as the models indicate changes that are less than normal year-to-year variations (NOAA 2013b).

Heavy precipitation events across the Southeast including southern Florida are expected to increase in both frequency and intensity. By the end of the century, an event that now typically occurs once in 20 years is projected to occur 2 to 3 times as often. Additionally, the number of tropical storms will decrease globally, but those that occur will be stronger in force, yielding more Category 4 and 5 storms. Rainfall rates associated with tropical storms are expected to be greater (USGCRP 2014).

Climate models are not in agreement when projecting changes in Atlantic hurricane activity; nonetheless, models agree that under a warmer climate, hurricane-associated rainfall rates and wind speed will increase (EPA 2016b, USGCRP 2014).

In 2017, the USGCRP's issued its Fourth National Climate Assessment report (USGCRP 2017), which includes updated sea level rise projections. The 2017 report updates NOAA's global sea level rise scenarios presented in the report, "Global Sea Level Rise Scenarios for the United States National Climate Assessment" (Parris et al. 2012) and which were previously used as the basis of the Southeast Florida Regional Climate Change Compact's 2015 sea level projections.

As for future sea levels, the USGCRP reports that, relative to the year 2000, global mean sea level is projected rise by 0.3 to 0.6 feet (0.09 to 0.18 m) by 2030 and 0.5 to 1.2 feet (0.15 to 0.37 m) by 2050 (USGCRP 2017). The USGCRP assigns very high confidence to the lower bounds of these projections and medium confidence to the upper bounds. For the first half of this century, future greenhouse gas emissions will have little effect as sea levels continue to rise, but emissions significantly affect levels beyond mid-century. Relative sea level rise on the East and Gulf Coasts of the United States is likely to be higher than the global average (USGCRP 2017).

Beyond the 2050 timeframe (and beyond the subsequent license renewal term for Turkey Point Units 3 and 4) and to the end of the century, sea levels are projected to continue to rise but the projections are subject to even greater uncertainty. In Appendix I, Section I.2 of the final EIS for the proposed Turkey Point Units 6 and 7 combined licenses (NUREG–2176, NRC 2016a), the NRC staff cited earlier sea level rise projections from the USGCRP (USGCRP 2014) of 1 to 4 feet (0.3 to 1.2 m) globally by the year 2100. NUREG-2176 also cited the "extreme high end" sea level rise estimate of 8.2 feet (2.5 m) by the year 2100 (NRC 2016a). In NUREG-2176, the NRC staff conjectured that should such a high rate of sea level rise occur, "much of South Florida would be uninhabitable and millions of people would likely be displaced." However, the NRC staff also observed that because sea level rise is likely to continue gradually, adaptation is possible (NRC 2016a). The latest consensus estimates from the USGCRP (USGCRP 2017) similarly indicate potential global sea level rise of 1 to 4.3 feet (0.3 to 1.3 m) by 2100. The

USGCRP assigned low confidence to the upper bounds estimates for the year 2100 in part because future greenhouse gas emissions drive sea level rise projections for the second half of the century. The USGCRP also indicated that sea level rise of 8 feet (2.4 m) or higher is physically possible, although the probability of that occurring could not be assessed at the time the report was written (USGCRP 2017). Nevertheless, it is apparent that future sea level rise is difficult to predict and is dependent on the amount of warming, ice melt from glaciers and ice sheets, and vertical land motion (e.g., local land subsidence or uplift) that may occur (USGCRP 2014, USGCRP 2017).

In 2015, the Southeast Florida Regional Climate Change Compact (SFRCCC or the Compact) published its update to the unified sea level rise projection. Its projections are intended for use by counties in the Southeast Florida compact to support planning with respect to potential vulnerabilities and the development of mitigation strategies to sea level rise (SFRCCC 2015).

The Compact produced sea level rise projections for three planning horizons (2030, 2060, and 2100). The projections for the medium term (i.e., 2060) most closely approximate the USGCRP's 2050 projections, which encompass the subsequent license renewal term for Turkey Point. Based on the Compact's estimates, relative to the year 1992, mean sea levels would rise 0.5 to 0.83 feet (0.15 to 0.25 m) by 2030 and 1.16 to 2.83 feet (0.35 to 0.86 m) by 2060. These estimates are referenced to the tidal gauge at Key West, FL. The Compact's projections (SFRCCC 2015), which are given in inches, have been converted to feet here for ease of comparison with those from the USGCRP (USGCRP 2017).

The NRC staff observes that in the short term (i.e., by the year 2030, or prior to the subsequent license renewal term), the Compact's regional estimates are not substantially different from the latest estimates produced by the USGCRP, although they diverge in the medium term (2050 to 2060). Specifically, the USGCRP projects sea level rise of 0.5 to 1.2 feet (0.15 to 0.37 m) by 2050, while the Compact projects a sea level rise of 1.16 to 2.83 feet (0.35 to 0.86 m) by 2060. The NRC staff observes that such divergence is not unexpected as uncertainty in the projections also increases with time. The Compact acknowledges as much, stating that, "sea level rise in the medium and long term has a significant range of variation as a result of uncertainty in future greenhouse gas emissions and their geophysical effects" (SFRCCC 2015).

The Compact's sea level rise estimates have some inherent differences as compared to the consensus-based estimates from the USGCRP. For example, the USGCRP's sea level rise estimates are relative to global mean sea level while the Compact's estimates are referenced to mean sea level at Key West, FL. The temporal baseline from which incremental sea level is measured also varies (year 2000 for USGCRP's current estimates versus 1992 for the Compact), a difference of 8 years over which time some sea level rise has inevitably already occurred. Accordingly, while they are useful for future planning, the various estimates are not directly comparable.

Based on the NRC staff's review, the staff considers the Compact's estimates to be conservative or bounding estimates (i.e., they reflect a higher sea level rise than would likely be observed based on the best available data from the USGCRP). As described in the Compact (SFRCCC 2015), sea level rise range estimates are based on the more conservative sea level rise projections or "curves" prepared by NOAA, the U.S. Army Corp of Engineers (USACE), and the Intergovernmental Panel on Climate Change (IPCC). Specifically, the Compact cites as the basis of its projections what is describes as the "NOAA high curve," the "USACE high curve," and the median of the IPCC Fifth Assessment Report's (AR5) RCP 8.5 scenario, which is described in the report, "Climate Change 2013: The Physical Science Basis" (IPCC 2013).

These scenarios in part define the upper bound (e.g., up to 2.83 feet (0.86 m) in sea level rise by 2060) of the Compact's projections.

The NOAA high curve adopted by the Compact is derived from the highest of four global sea level rise scenarios (i.e., highest, intermediate-high, intermediate-low, and lowest) presented in NOAA Technical Report OAR CPO-1 (Parris et al. 2012). As stated by Parris et al. (Parris et al. 2012), the highest scenario, in part, assumes "the maximum possible glacier and ice sheet loss." Similarly, with regard to the USACE high curve, USACE Technical Letter No. 1100-2-1 (DOA 2014) indicates that the USACE high curve exceeds the upper boundaries for projected sea level rise from the IPCC for 2001, 2007, and 2013. The curve further accounts for the possibility of rapid ice loss from Antarctica and Greenland, and generally falls between the highest and intermediate high curves given in Parris (Parris et al. 2012). Finally, the Compact's adoption of RCP 8.5 represents another rather conservative assumption. As noted in the USGCRP report (USGCRP 2017), the RCP 8.5 scenario in part assumes that global carbon emissions continue to rise steadily due to continued fossil fuel combustion, whereas other scenarios reflect varying reductions in emissions.

Based on the studies referenced above, it is apparent that rising sea levels will continue to have measurable hydrologic effects on coastal communities, but those effects may vary in severity on a local and regional basis. As sea levels rise, the incidence of tidal flooding in coastal areas due to all coastal storms will increase, as will the depth and extent of such flooding. Further, the USGCRP reports that there is medium confidence that the intensity of North Atlantic hurricanes will increase, thus increasing the chances of extreme flooding along the East and Gulf Coasts. However, there is a low level of confidence in the projected increase in frequency of Atlantic hurricanes (USGCRP 2017).

Changes in climate have broader implications for public health, water resources, land use and development, and ecosystems. For instance, changes in precipitation patterns and increases in air temperature can affect water availability and quality, distribution of plant and animal species, land use patterns, and land cover, which can, in turn, affect terrestrial and aquatic habitats. In Section 4.16 of this SEIS, the NRC staff considers the potential cumulative, or overlapping, impacts from climate change on environmental resources that could also be impacted by the proposed action (subsequent license renewal).

The effects of climate change on Turkey Point Unit 3 and 4 structures, systems, and components are outside the scope of the NRC staff's license renewal environmental review. The environmental review documents the potential effects from continued nuclear power plant operation on the environment. Site-specific environmental conditions are considered when siting nuclear power plants. This includes the consideration of meteorological and hydrologic siting criteria as set forth in 10 CFR Part 100, "Reactor Site Criteria." Turkey Point was designed and constructed in accordance with 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants." NRC regulations require that plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions. Further, nuclear power plants are required to operate within technical safety specifications in accordance with the NRC operating license, including coping with natural phenomena hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes due to changing environmental conditions. Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure ongoing safe operations under the plant's initial and renewed operating licenses, through the NRC's Reactor Oversight Program. If new information about changing environmental conditions (such as rising sea levels that threaten safe operating conditions or challenge compliance with the plant's technical specifications) becomes available, the NRC will evaluate the new information to determine if any safety-related changes are needed at licensed nuclear power plants. This is a separate and distinct process from the NRC staff's subsequent license renewal environmental review that it conducts in accordance with the National Environmental Policy Act (NEPA). Nonetheless, as discussed below, the NRC staff considers the impacts of climate change in combination with the effects of subsequent license renewal, in assessing cumulative impacts. That discussion is provided in Section 4.16 of this SEIS.

4.16 Cumulative Impacts

Cumulative impacts may result when the environmental effects associated with the proposed action (e.g., subsequent license renewal) are added to the environmental effects from other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. An effect that may be inconsequential by itself could result in a greater environmental impact when combined with the effects of other actions. As explained in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the GEIS) (NRC 2013a), the effects of the license renewal action combined with the effects of other actions could generate cumulative impacts on a given resource.

For the purposes of this analysis, past actions are those that occurred since the commencement of Turkey Point Units 3 and 4 reactor operations and prior to the submittal of the license renewal application. Older actions are considered as part of the affected environment in Chapter 3 of this SEIS. Present actions are those that are occurring during current power plant operations. Future actions are those that are reasonably foreseeable to occur through the end of power plant operation, including the period of extended operation. Therefore, the cumulative impacts analysis considers potential effects through the end of the current license term, as well as through the end of the 20-year subsequent license renewal term.

The cumulative impacts analysis accounts for both geographic (spatial) and time (temporal) considerations of past, present, and reasonably foreseeable future actions to determine whether other potential actions are likely to contribute to the total environmental impact. In addition, because cumulative impacts accrue to resources and focus on overlapping impacts with the proposed action, no cumulative impacts analysis was performed for resource areas where the proposed action is unlikely to have any incremental impacts on that resource. For example, since FPL is prohibited from discharging effluents into surface waters of the State, and the FDEP and DERM have imposed requirements for mitigation of the hypersaline plume originating from the CCS, subsequent license renewal is not expected to have a cumulative impact on surface water quality in combination with rising sea levels. Consequently, no cumulative impacts analysis was performed for the following resource areas: land use, noise, surface water, and geology and soils.

As noted in Section 4.15.3.2, "Climate Change," of this SEIS, changes in climate could have broad implications for certain resource areas. Accordingly, a climate change impact discussion is provided for those resource areas that could be incrementally impacted by the proposed action (subsequent license renewal). It is also important to note that the potential effects of climate change would occur irrespective of the proposed action.

Information from FPL's environmental report; responses to requests for additional information; information from other Federal, State, and local government agencies; scoping comments; and information gathered during the NRC staff's visit to Turkey Point were used to identify past, present, and reasonably foreseeable future actions in the cumulative impacts analysis. To evaluate cumulative impacts resulting from the continued operation of Turkey Point Units 3 and 4, the incremental impacts of the proposed action, as described in Sections 4.2 to 4.13 of this SEIS, are combined with the impacts of other past, present, and reasonably foreseeable future actions regardless of which agency (Federal or non-Federal) or person undertakes such actions. In general, the effects of past actions have already been described in Chapter 3 of this SEIS, the affected environment, which serves as the environmental baseline for the cumulative impacts analysis.

Chapter 7.0 of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) provides a recent analysis of cumulative impacts at the Turkey Point site resulting from the construction and operation Turkey Point Units 6 and 7. Table 7-1 in NUREG-2176 identifies the past, present, and reasonably foreseeable future actions and other actions near the Turkey Point site, including Everglades restoration, and other energy, mining, and transportation projects considered in the analysis. All of this information is incorporated here by reference (NRC 2016a: pages 7-1 through 7-46).

The NRC staff identified as an additional future action, a plan that SDI Aggregate, LLC, a private project located at a quarry approximately 5.5 mi (9 km) west of Turkey Point, has to install a series of injection wells to mitigate the progression of saltwater intrusion westward. The South Florida Water Management District issued a consumptive use permit for this project in 2017 (SFWMD 2017a).

In addition, two potential future actions at the Turkey Point site were identified during the subsequent license renewal review: (1) the possible construction and operation of a Miami-Dade County wastewater treatment facility and (2) the possible expansion of the Turkey Point Units 3 and 4 independent spent fuel storage installation (ISFSI). FPL and Miami-Dade County have agreed to investigate the potential to create a tertiary wastewater treatment facility that could provide up to 60 million gallons (approximately 230 million liters) per day of reclaimed wastewater for use at the Turkey Point site. Possible uses for this treated wastewater would include makeup water for Turkey Point Unit 5 forced draft cooling towers and freshening water to assist in managing salinity in the cooling canal system (CCS). If constructed, this tertiary wastewater treatment facility could provide reclaimed water to the CCS during the subsequent license renewal period of extended operations. To date, FPL and Miami-Dade County have not yet committed to building this facility.

FPL may also need to expand the Turkey Point Units 3 and 4 ISFSI, which could require the construction of a new ISFSI pad to accommodate additional spent nuclear fuel generated during the subsequent license renewal term, if DOE does not begin to take ownership of the spent nuclear fuel in 2031 (FPL 2018g). Conversely, FPL may choose to utilize a higher density storage system to create additional storage capacity, thereby reducing the need to expand the ISFSI. As a result, FPL has not yet determined whether it would expand the ISFSI.

Regardless, if implemented, each of these actions would likely be completed prior to the commencement of the subsequent license renewal term. No other new and significant information was identified during the NRC staff's review of FPL's environmental report for Turkey Point Units 3 and 4 (FPL 2018f), the site audit, the scoping process, or the evaluation of other available information since the Turkey Point Units 6 and 7 COL EIS was issued (NUREG 2176) (NRC 2016a).

4.16.1 Air Quality

The region of influence (ROI) that the NRC staff considered in the cumulative air quality analysis is Miami-Dade County because air quality designations in Florida are made at the county level. FPL has not proposed any refurbishment-related activities during the subsequent license renewal period. As a result, the NRC staff expects that air emissions at Turkey Point during the subsequent license renewal period would be similar to those presented in Section 3.3.2, "Air Quality." Table 7-1 of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), which is incorporated by reference in Section 4-16 of this SEIS, provides a list of present and reasonably foreseeable future projects that could contribute to cumulative impacts to air quality in Miami-Dade County. Current air emission sources operating in Miami-Dade County have not resulted in long-term National Ambient Air Quality Standards (NAAQS) violations given the designated unclassifiable/attainment status for all NAAQS in Miami-Dade County. Consequently, cumulative changes to air quality in Miami-Dade County would be the result of future projects and actions that change present-day emissions within the county.

The development and construction activities identified above in Section 4.16 and those identified in Table 7-1 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a) can increase air emissions during their respective construction periods, but those air emissions would be temporary and localized. However, future operation of new commercial and industrial facilities and increases in vehicular traffic can result in overall long-term air emissions that contribute to cumulative air quality impacts. Any entity establishing new stationary sources of emissions in the region of influence would be required to apply for an air permit from the Florida Department of Environmental Protection and would also be required to operate in accordance with applicable Federal, State, and local regulatory requirements.

Climate Change

Climate change can impact air quality as a result of changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007). Ozone has been found to be particularly sensitive to climate change (IPCC 2007; EPA 2009a). Ozone is formed, in part, as a result of the chemical reaction of nitrogen oxides and volatile organic compounds in the presence of heat and sunlight. Sunshine, high temperatures, and air stagnation are favorable meteorological conditions for higher levels of ozone (IPCC 2007, EPA 2009b). The emission of ozone precursors also depends on temperature, wind, and solar radiation (IPCC 2007). According to the U.S. Environmental Protection Agency (EPA), both nitrogen oxide and biogenic volatile organic compound emissions are expected to be higher in a warmer climate (EPA 2009a). Although surface temperatures are expected to increase in the Southeast region of the United States (where Turkey Point is located), this may not necessarily result in an increase in ozone concentrations (Diem et al. 2017). For instance, during the fall in the Southeast, ozone concentrations correlate with humidity (Zhang and Wang 2016). Wu et al. (Wu et al. 2008) modeled changes in ozone levels in response to climate change and found negligible climate change-driven ozone concentrations for the Southeast region. Tao et al. (Tao et al. 2007) found differences in future changes in ozone for the Southeast with decreases in ozone concentrations under a low-emission-modelled scenario and increase under a high-emission-modelled scenario. Among modelled studies of climate-related ozone changes, model simulations for the Southeast region have the least consensus. Therefore, the potential cumulative impact to air quality ozone levels in the vicinity of Turkey Point due to climate change is unknown.

4.16.2 Water Resources

4.16.2.1 Groundwater Resources

The description of the affected environment in Section 3.5.2, "Groundwater Resources," of this SEIS serves as the baseline for the NRC staff's cumulative impacts assessment for groundwater resources. For groundwater, the geographic area of interest is comprised of the local and regional aquifer systems potentially affected by Turkey Point operations, the surficial (i.e., Biscayne) and Floridan aquifer systems. As such, this review focuses on those projects and activities that would withdraw water from, or discharge effluents to, the referenced aquifer systems.

<u>Water Use Considerations</u>

As part of the NRC staff's analysis for proposed Units 6 and 7, Sections 7.2.1.2, "Groundwater-Use Impacts," and Appendix G, Section G.3.2.3, "Summary of Review Team Focused Modeling," of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176, NRC 2016a: 7-13–7-14, G-46–G-48) evaluate the cumulative impacts on groundwater use. The analysis considered preconstruction, construction, and operations of proposed Units 6 and 7 as well as the other past, present, and reasonably foreseeable future actions that could affect groundwater uses, including some ongoing activities at the Turkey Point site and the potential continued operation of Turkey Point Units 3 and 4 through subsequent license renewal. In summary, the NRC staff concluded the following:

- The impacts from NRC-authorized construction and operations on groundwater use would be SMALL, and no further mitigation would be warranted beyond the State of Florida Siting Board's final conditions of certification (State of Florida Siting Board 2014).
- Limited operation of the radial collection wells would have minor impacts on Biscayne aquifer users, although continued development and increased groundwater use could lower groundwater levels in the aquifer and cause further inland movement of the saltwater interface.
- Alterations in hydraulic head beneath the CCS associated with the addition of groundwater to the CCS for freshening combined with operation of recovery wells for remediation of the hypersaline groundwater plume would result in some increase flow of surficial groundwater from the west as well as CCS water toward FPL's proposed radial collection wells. Radial collection well operation would result in minor localized alterations in salinity distribution.

The NRC staff incorporates here by reference these findings from the EIS for the Turkey Point Units 6 and 7 combined licenses (NRC 2016a: 7-13–7-14, G46–G-48).

Section 4.5.1.2 of this SEIS, "Conflicts Analysis for the Upper Floridan Aquifer," separately describes and evaluates the potential impacts of FPL's withdrawals from the Upper Floridan aquifer. FPL is authorized to withdraw 14.06 mgd (53,200 m^3/d) of groundwater from the upper production zones of the Upper Floridan aquifer for cooling water for Turkey Point Unit 5 and process water for Units 1, 2, 3, 4, and 5 (i.e., from three saline production wells). FPL is authorized to withdraw an additional 14 mgd (53,000 m^3/d) from the freshening well system (i.e., wells F-1, F-3, F-4, F-5, F-6). These withdrawals are authorized under the modified site certification and associated conditions of certification for the Turkey Point site (State of Florida Siting Board 2016, FDEP 2016b). FPL commissioned Tetra Tech, a consulting and engineering services firm, to prepare a technical evaluation and associated groundwater flow model (Tetra Tech 2014) to evaluate the proposed freshening withdrawals from the Upper Floridan aquifer to support FPL's 2014 site certification modification for Turkey Point (FPL 2018n).

The technical evaluation and results indicate that operation of the freshening well system at the maximum rate of 14 mgd (53,000 m^3/d) could result in maximum, offsite drawdowns of up to 2.26 feet (0.7 m) at the Miami-Dade Water and Sewer Department's (MDWSD's) South Miami Heights wellfield, located approximately 10.3 mi (16.6 km) north, northwest of the center point of FPL's freshening well system. Further, modeling shows that the incremental drawdown from freshening well system operations could account for 5 percent to as much as 19 percent of the total predicted cumulative drawdown from all permitted withdrawals from the Upper Florida aquifer at offsite locations. Specifically, the modeling projects incremental drawdown of up to 2.21 feet (0.67 m) at Sound Golf Club and Ocean Reef Club (about 9 mi (14 km) south of the FPL freshening wells); these drawdowns account for 19 percent of the total cumulative drawdown at these locations (Tetra Tech 2014).

While the reported modeling results reflect conservative, bounding-case impacts, the results nonetheless indicate the potential for measurable cumulative impacts on groundwater within the Upper Floridan aquifer. However, the NRC staff finds that the magnitude of FPL's withdrawals and projected cumulative drawdowns would be unlikely to preclude aquifer availability and cause groundwater use conflicts for other users based on the aquifer yields, total thickness, and regional extent, under current conditions. In addition, the State-issued modified site certification and associated conditions of certification for the Turkey Point site (State of Florida Siting Board 2016, FDEP 2016b) require FPL to mitigate harm to offsite groundwater users (either related to water quantity or quality) as well as to offsite water bodies, land uses, and other beneficial uses. As necessary, the South Florida Water Management District could require FPL to reduce withdrawals or undertake other mitigative actions, as further described in Section 4.5.1.2 of this SEIS.

Implementation of the proposed project to treat up to 60 mgd (227,000 m^3/d) of sanitary wastewater from Miami-Dade County for use by FPL at the Turkey Point site would likely have net, beneficial cumulative impacts on groundwater use. Using treated sanitary wastewater in the CCS would potentially reduce or eliminate the need to operate FPL's freshening well system, which conveys artesian groundwater from the Upper Floridan aquifer into the CCS for salinity management. Any reduction in groundwater withdrawals from the Upper Floridan aquifer would reduce regional aquifer drawdown.

Operation of the proposed freshwater injection system at the limestone quarries located approximately 5 mi (8 km) west of the CCS and Turkey Point property would be likely to have net, beneficial cumulative impacts on groundwater use and quality. As proposed and permitted by SFWMD, the project would entail the withdrawal of up to 5 mgd (19,000 m^3/d) of freshwater groundwater from a single well completed to a depth of 40 feet (12 m). This water would then be reinjected into the aquifer through a series of 14, 75-foot (23-m) deep injection wells that are aligned along the eastern edge of the quarry property. Reinjection of the groundwater is intended to form an eastward hydraulic barrier to protect the quarry property from encroachment of the regional saltwater interface (SFWMD 2017a). The system is also expected to contribute to efforts to retract the regional saltwater interface to the east, working in conjunction with FPL's recovery well system, as evaluated in Section 4.5.1.2 of this SEIS. The modeling performed by the project applicant and reviewed by SFWMD staff, as documented in its staff report, indicates that operation of the system would have minimal offsite drawdown in the Biscayne aquifer (SFWMD 2017a).

The NRC staff assumes that the freshwater injection system at the limestone quarries would continue at least as long as operation of FPL's recovery well system, since it is intended to work alongside FPL's recovery well system. As stated in Section 4.5.1.2 of this SEIS, current modeling projections indicate that FPL's recovery well system will be successful in retracting the hypersaline plume back to within the boundaries of the CCS within 10 years of startup (i.e., by about 2028) while also retracting the saltwater interface back to the east from its current location. If these projections are realized, then it is possible that neither the freshwater injection system project nor FPL's recovery well system will be operating by the start of Turkey Point's subsequent license renewal term (i.e., 2032 for Unit 3 and 2033 for Unit 4). In that case, neither activity would contribute to cumulative impacts associated with the proposed action (subsequent license renewal).

<u>Water Quality Considerations</u>

In Section 7.2.2.2, "Groundwater-Quality Impacts," of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176, NRC 2016a), the NRC staff presented its evaluation of the potential cumulative impacts on groundwater quality. The analysis considered preconstruction, construction, and operations of proposed Units 6 and 7 as well as the other past, present, and reasonably foreseeable future actions that could affect groundwater quality, including some ongoing activities at the Turkey Point site and the potential continued operation of Turkey Point Units 3 and 4. In summary, the NRC staff concluded the following:

- The impacts from NRC-authorized construction and operations on groundwater quality would be SMALL, and no further mitigation would be warranted beyond the State of Florida Siting Board's final conditions of certification (State of Florida Siting Board 2014).
- Ongoing and future actions being undertaken by Federal, State, and local government agencies to enhance freshwater recharge of the Biscayne aquifer would potentially have a positive impact on groundwater quality by reducing the potential for westward movement of the saltwater interface.
- The addition of brackish water from the Upper Floridan aquifer to the CCS would be likely to lower temperature, salinity, and concentration of other constituents in the CCS; this would result in lower salt concentrations in water seeping out of the CCS and into the Biscayne aquifer and thus reduce impacts on the Biscayne aquifer.
- Deep well injection of wastewater into the Boulder Zone proposed for Units 6 and 7 combined with wastewater injection operations at the Miami-Dade South District Wastewater Treatment Plant would be unlikely to contribute to cumulative effects on groundwater quality in the Boulder Zone or result in degradation of groundwater quality in the overlying Upper Floridan aquifer.
- Mining operations in the region to support construction of Turkey Point Units 6 and 7 could affect groundwater quality by increasing salinity in underlying groundwater, but regulation of mining operations would ensure that cumulative impacts would be minor.

The NRC staff incorporates here by reference all of the above findings (NRC 2016a: 7-13, 7-16–7-18).

As previously described, the operation of FPL's recovery well system is projected to be successful in retracting the hypersaline plume back to within the boundaries of the CCS within 10 years of startup (i.e., by about 2028) while also retracting the saltwater interface back to the east from its current location. This would result in beneficial impacts on groundwater quality within the Biscayne aquifer (i.e., Class G-II groundwater) to the west of the CCS and the Turkey Point site as well as in the portions of the aquifer beneath Biscayne Bay affected by CCS operations. The NRC staff finds that it is reasonable to expect that FPL's freshening well system would continue to be operated during the subsequent license renewal term, and for as long as necessary to maintain compliance with the terms of the 2015 consent agreement with Miami-Dade County DERM (MDC 2015a) and the 2016 FDEP consent order (FDEP 2016e). The continuation of CCS freshening (salinity management) activities would ensure that the average annual salinity of the CCS is maintained at or below 34 PSU, to control the generation and migration of a hypersaline plume in groundwater. The NRC staff expects that continued operation of the freshening system, combined with proper operation and maintenance of the CCS, will result in no substantial contribution to cumulative impacts on groundwater quality or associated impacts on surface water quality in Biscayne Bay during the subsequent license renewal period.

Climate Change and Related Considerations

The NRC staff considered the best available information regarding the potential impacts of climate change at a regional and local scale, including the U.S. Global Change Research Program's (USGCRP's) most recent compilations of the state of knowledge relative to global climate change effects (USGCRP 2014, USGCRP 2017). In Appendix I, Section I.3.2 of the final EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176, NRC 2016a), the NRC staff considered potential hydrologic changes related to climate change. Climate change can impact groundwater availability and quality as a result of changes in temperature and precipitation, as well as due to sea level rise.

As discussed in Section 4.15.3.2, "Climate Change," of this SEIS, average annual temperature across the lower east coast region of South Florida has increased at a rate of 0.2 °F (0.11 °C) per decade and is projected to continue to increase by up to 3.5 °F (1.9 °C) by 2050. Although annual precipitation data show no clear trend, climate model simulations indicate a slight decrease in annual mean precipitation by 2050. However, heavy precipitation events are expected to increase in both frequency and intensity. Changes in temperature and precipitation have important implications for near- or at-surface water table aquifers, such as the Biscayne aquifer of South Florida (see Section 3.5.2.1, "Hydrogeology and Aquifers," of this SEIS), which is locally recharged by local precipitation and runoff and is the primary source of water supply for Miami-Dade County. An increase in average annual temperature without any increase in annual precipitation would likely increase evapotranspiration and reduce recharge to the Biscayne aquifer. Projected increases in heavy precipitation events could increase recharge during the timeframe when they occur. However, increases in heavy precipitation events and intensity without an annual increase in total precipitation would be unlikely to compensate for decreased recharge throughout the year.

The effects of climate change are projected to significantly increase water demand across most of the United States. Water demand across South Florida is projected to increase by more than 50 percent by 2060, relative to 2005, based on combined changes in population, socioeconomic conditions, and climate (NRC 2016a) (USGCRP 2014, Figure 3.11). For most of Florida, this increase in demand is forecast even without assuming climate change (USGCRP 2014, Figure 3.11). Regardless, climate change, mainly due to increases in temperature and evapotranspiration, would decrease water availability and further drive demand.

By about 2050, the USGCRP projects that global sea levels may rise by an additional 0.5 to 1.2 feet (0.15 to 0.37 m). This rise is likely to be higher along the East Coast of the United

States (USGCRP 2017). Higher sea levels will increase the rate of saltwater intrusion (encroachment) into coastal freshwater supplies (USGCRP 2014). This is particularly true for the Biscayne aquifer, as referenced previously, but also for the confined, Upper Floridan aquifer, which is a designated underground source of drinking water across South Florida (see Sections 3.5.2.1 and 3.5.2.2 of this SEIS).

A rise in sea level would have the most direct impacts on the Biscayne aquifer. Currently, the saltwater interface is located about 4.7 mi (7.6 km) west of the Turkey Point site and the CCS at its closest point, as described in Sections 3.5.2.1 and 3.5.2.2 of this SEIS. As sea levels rise, saltwater from the east would move along the base of the Biscayne aquifer, pushing the saltwater interface farther to the west from its current location. Combined with sea level rise, decreases in recharge to the Biscayne aquifer would reduce the freshwater hydraulic head in the Biscayne aquifer, further increasing the potential for westerly migration of the saltwater interface across Miami-Dade County.

The potential for additional saltwater intrusion has significant implications for Miami-Dade County, other public water supply systems, and private and industrial users of the Biscayne and other affected aquifers. Increased salinity levels in groundwater supplies would increasingly require public and private groundwater users to invest in treatment technologies (e.g., desalination), to relocate supply wells and supporting infrastructure, to seek out and develop new water supply sources, or to pursue a combination of approaches to manage degraded groundwater quality.

4.16.3 Terrestrial Resources

The description of the affected environment in Section 3.6, "Terrestrial Resources," of this SEIS serves as the baseline for the NRC staff's cumulative impacts assessment for terrestrial resources. For terrestrial resources, the geographic area of interest is comprised of the Turkey Point site and offsite wetlands that could be impacted by FPL's efforts to recover and extract the hypersaline water within and around the CCS as described in Section 3.6.1, "Vegetative Communities."

In Section 7.3.1 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176, NRC 2016a), the NRC staff described the cumulative impacts that terrestrial resources on and near the Turkey Point site may experience. In its assessment, the 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 future activities considered in the analysis included urban development, energy production, mining, manufacturing, transportation and infrastructure development, and other miscellaneous activities that could affect terrestrial and wetland resources. The NRC staff (NRC 2016a) also considered current efforts to restore or improve ecological habitat, including the Comprehensive Everglades Restoration Program and the Southern Glades Addition. in addition, the NRC staff's cumulative impacts analysis (NRC 2016a) considered the overlapping impacts of construction and operation of proposed Turkey Point Units 6 and 7 with the impacts from continued operations at Units 3 and 4, such as any impacts to offsite wetlands from the removal of water from the L-31E Canal during periods of excess flow, for use in freshening the CCS. Appendix I, Section I.3.3 describes the potential overlapping impacts with climate change. The NRC staff incorporates here by reference the above cumulative impacts analyses from NUREG-2176 (NRC 2016a, Section 7.3.1, pages 7-19 to 7-23).

Since the NRC published the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176) (NRC 2016a), the NRC staff has determined that the possible construction and operation of a mine and a Miami-Dade County wastewater treatment facility, as well as the expansion of the Turkey Point Units 3 and 4 ISFSI, could result in additional overlapping impacts to wetlands and other important terrestrial resources. Construction could result in both the permanent and temporary loss of important terrestrial habitats, habitat fragmentation, and habitat degradation as a result of runoff, erosion, and sedimentation. Wildlife and birds would likely avoid the area during construction due to noise and other disturbances. Collisions with tall structures and vehicles could also result in mortality. However, the 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 within previously disturbed areas would minimize any potential impacts to important terrestrial habitats. FPL (FPL 2018g) determined that if Turkey Point requires a new ISFSI, the preferable candidate site would be located on previously disturbed land within or adjacent to the Units 3 and 4 protected area.

4.16.4 Aquatic Resources

The description of the affected environment in Section 3.7, "Aquatic Resources," in this SEIS serves as the baseline for the NRC staff's cumulative impacts assessment for aquatic resources. For aquatic resources, the geographic area of interest is comprised of the CCS and other surface waters on the Turkey Point site (i.e., the hypersaline mudflats, remnant canals, channels, dwarf mangrove wetlands, and open water areas described in Section 3.7.3, "Aquatic Resources on the Turkey Point Site") as well as Biscayne Bay. As such, this review focuses on those projects and activities that would affect the aquatic biota and habitats within this geographic area.

Many natural and human activities influence the characteristics of these aquatic environments and the condition of the aquatic resources found in them. In Section 4.7.1, "Proposed Action," the NRC staff concludes that impingement, entrainment, and thermal effects associated with the proposed subsequent license renewal would result in SMALL to MODERATE effects on the aquatic resources of the CCS. These effects would not apply to aquatic resources within Biscayne Bay because there are no surface water connections that allow aquatic organisms inhabiting the Bay to interact with Turkey Point's intake or discharge. All other potential impacts of subsequent license renewal on aquatic resources would be SMALL. In Section 7.3.2 of the EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176), the NRC (NRC 2016a) staff considered a number of past, present, and reasonably foreseeable future actions whose effects could overlap, resulting in cumulative impacts on the aquatic resources on the Turkey Point site and within Biscayne Bay. In its analysis, the NRC staff evaluated the following cumulative effects, which the staff hereby incorporates by reference.

- Historical context of the region, including prior drainage, development, and other modifications within South Florida (pages 7-24 to 7-25)
- Existing units on the Turkey Point site (i.e., Units 1, 2, 3, 4, and 5) (pages 7-25 to 7-26)
- Ecological restoration initiatives and management programs, including the Model Lands Basin and Southern Glades Addition; the Biscayne Bay Park Fishery Management Plan; the Comprehensive Everglades Restoration Program; and Florida Keys National Marine Sanctuary (pages 7-26 to 7-28)

- Population growth and coastal development (pages 7-28 to 7-29)
- Future construction and operation of Turkey Point Units 6 and 7 (Section 4.3.2; summarized on pages 4-97 to 4-98)

The NRC staff considers the following additional actions below: the past and current operations of the CCS, the possible construction and operation of several new industrial facilities, and climate change.

Past and Current Operations of the CCS

The CCS supports the operation of Turkey Point Units 3 and 4 as well as Turkey Point Units 1 and 2. Although Units 1 and 2 no longer generate electricity, their use of the CCS as a cooling water source has contributed to the changes in the CCS over time. Currently, Units 1 and 2 circulate a small amount of water from the CCS to support synchronous condenser mode. However, because Units 1 and 2 no longer produce steam, they do not discharge heated water to the CCS. Section 3.1.3.2, "Cooling Canal System," of this SEIS contains a detailed description of the CCS and its operation. Section 3.5.1.4 of this SEIS describes water quality in the CCS and adjacent surface waters as well as the State-required monitoring and mitigation that FPL has undertaken or is in the process of undertaking. As described in these sections, the CCS began experiencing a visible ecosystem shift beginning in 2010 and CCS water quality has deteriorated over the past decade. The average salinity of the CCS has increased, water quality and clarity have degraded, and average surface water temperatures have increased. Seagrass colonies died off, and the subsequent decomposition of dead organic matter released a significant volume of nutrients into the CCS. This facilitated algae blooms, which resulted in high turbidity and further degraded water quality. Whereas the CCS had previously been a seagrass-based ecological system, it now 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. As discussed in Section 4.7.1.2, "Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)," a number of species of fish, mollusks, crabs, and seagrasses have disappeared from the CCS in recent years. Thermal stress is one factor that has likely contributed to these disappearances (EAI 2017).

FPL is in the process of implementing a Nutrient Management Plan as a requirement of the Florida Department of Environmental Protection consent order. The plan includes an initiative to re-establish seagrass meadows in the CCS. FPL (FPL 2016k) states in its Nutrient Management Plan that a healthy seagrass population growing over approximately 50 percent of the CCS surface water acreage would help balance and sequester the CCS's nutrient content. FPL's plan to re-establish seagrass is described in more detail in Section 3.7.3, "Aquatic Resources on the Turkey Point Site," of this SEIS. To date, FPL has identified no clear evidence that the CCS is having an ecological impact on Biscayne Bay or other adjacent surface waters (see Section 3.7.4, "Biscayne Bay and Card Sound Semiannual Monitoring," for more details) (E&E 2017).

Possible Construction and Operation of New Industrial Facilities

Since the NRC published its EIS for the Turkey Point Units 6 and 7 combined licenses in 2016 (NRC 2016a), the NRC staff has identified several new industrial facilities that may be constructed and operated in the vicinity of the Turkey Point site. These include a mine, a Miami-Dade County wastewater treatment facility, and the expansion of the Turkey Point ISFSI. Construction (or expansion) of these facilities could result in the temporary or permanent loss of wetlands and mangrove forests that function as important habitats for early life stages of fish and shellfish. Any permanent losses of aquatic habitats could create habitat fragmentation that would affect ecosystem function and connectivity. Habitat degradation associated with runoff, erosion, and sedimentation during construction could also occur. Additionally, direct mortality of aquatic organisms could result from dredging, wetland and mangrove filling, and other necessary in-water work. Barge traffic associated with delivery of construction supplies and plant components to the site would release pollutants into aquatic habitats and could result in collision-related mortality of larger aquatic organisms, especially turtles and marine mammals. Appropriate permits would mitigate some water quality and aquatic resource impacts by requiring implementation of best management practices or other mitigation during construction and/or operation. The U.S. Army Corps of Engineers or the Florida Department of Environmental Protection would oversee applicable Clean Water Act permitting, including Section 404 permits for dredging and fill activities, Section 401 certification, and Section 402(p) NPDES general stormwater permitting. Once built, operation of these new facilities would likely have minimal to no discernable impacts on aquatic resources.

Climate Change

Section 4.15.3.2, “Climate Change,” of this SEIS describes current climate change research and predictions across the contiguous United States as well as specific to the Southeast region of the United States and South Florida. The NRC staff also describes in that section the climate changes expected to occur over the course of the Turkey Point subsequent license renewal term, based on currently available climate model simulations. The primary climate changes that could affect aquatic resources during this timeframe include sea level rise of between 0.5 to 1.2 feet (0.15 to 0.37 m) by 2050 and increased storm frequency and intensity.

Sea level rise would likely alter the hydrological regime and flow and could result in saltwater intrusion, erosion, and inundation of coastal areas. This would affect the quality, quantity, and spatial distribution of wetlands and mangrove forests. Some of these habitats could become open water, which would reduce available nursery habitat for early life stages of many fish and shellfish. Loss of such habitats could affect the success of ongoing and planned restoration activities in the region. For example, in an analysis of the effects of climate-induced sea level rise on the success of the Biscayne Bay Coastal Wetlands Phase 1 Project, the U.S. Army Corps of Engineers and the South Florida Water Management District estimated that by 2032, approximately 8 percent of the project’s ecosystem benefits were likely to be at risk from sea level rise; and by 2062, the project’s expected benefits would be diminished by 41 percent (USACE and SFWMD 2011).

Storm frequency and duration would also affect aquatic habitats and coastal wetlands and mangroves. If storm intensities and durations increase, these important habitats would be more likely to suffer damage, which could affect hydrological regimes, quality, quantity, and ecosystem function until those habitats recover. Also, with increased storm frequency, these habitats would not have as much time to recover between storms. This would affect the coasts’ ability to serve as a nursery for fish and shellfish, and this could have cascading population effects over time for those species that are highly dependent upon wetlands and mangroves during early life stages.

Another potential climate change-induced stressor on the aquatic environment in the geographic area of interest is the likely use of additional shoreline infrastructure or armoring to protect cities, urban areas, roads, bridges, and agricultural lands from rising sea levels. For instance, in Miami-Dade County, 4,358 km^2 (2,708 mi^2) of land are at elevations of 5 m (16.4 feet) or less, and 3,500 km^2 (2,174 mi^2) of land are 2 m (6.6 feet) or lower (Cela et al. 2010). Shoreline protection efforts in these areas could contribute to habitat fragmentation or interfere with activities designed to restore historic hydrological flow and ecological connections. Dredging and other in-water work associated with shoreline protection infrastructure could result in erosion, sedimentation, and water-quality degradation, although implementation of best management practices and appropriate State and Federal water quality permits would mitigate such effects. Direct injury or mortality of aquatic organisms could also result from these activities. Associated barge traffic and construction equipment use would release pollutants into aquatic habitats and could result in collision-related injury or mortality of larger aquatic organisms, especially turtles and marine mammals. Coupled with continued population growth and urbanization, shoreline protection infrastructure that becomes a permanent part of the coastal landscape could dramatically influence the future of aquatic resources in South Florida.

4.16.5 Socioeconomics

This section addresses socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Turkey Point in addition to the aggregate effects of other past, present, and reasonably foreseeable future actions. The region of influence (ROI) considered in this cumulative analysis is Miami-Dade County, where approximately 85 percent of FPL employees reside (see Table 3-13). This is where the economy, tax base, and infrastructure would most likely be affected because the majority of Turkey Point workers and their families reside, spend their incomes, and use their benefits within Miami-Dade County. As discussed in Section 4.10, "Socioeconomics," continued operation of Turkey Point during the subsequent license renewal period would result in SMALL socioeconomic impacts.

Past, present, and reasonably foreseeable future actions within the ROI could contribute to cumulative socioeconomic impacts. Relevant actions in this cumulative impact analysis include future planned activities at the Turkey Point site that are unrelated to the proposed action of subsequent license renewal, future urbanization, population increases, transportation infrastructure projects, and other reasonably foreseeable planned offsite activities. Future activities and planned projects in the ROI could bring additional workers and traffic, thus increasing the local population and causing increased traffic on local roads and increased demand for public services. For instance, the construction and operation of the proposed new Turkey Point Units 6 and 7 would have an impact on Miami-Dade County's economy including impacts from traffic in the immediate vicinity of the Turkey Point site (NRC 2016a). For instance, construction and operation of Turkey Point Units 6 and 7 would result in beneficial socioeconomic impacts including additional wages, tax revenue, and jobs. However, construction and operation of Turkey Point Units 6 and 7 would have adverse impacts on traffic as a result of additional worker and delivery vehicles. Transportation infrastructure projects throughout the region can have beneficial impacts on road quality and infrastructure. Miami-Dade County has experienced increased migration into the county as a result of the continuing effects of Hurricane Maria, which occurred in 2017 (BEBR 2018); increases in population (see Table 3-17) can increase the demand for public services.

Changes in climate conditions could impact certain industries such as tourism and recreation, which create jobs and bring significant revenue to regional economies. The U.S. Global Change Research Program reports that climate changes (increases in ambient temperatures and humidity) in the Southeast region of the United States by the year 2050 could create unfavorable summertime outdoor conditions for recreation and tourism (USGCRP 2014). The Everglades and Florida Keys are vulnerable to sea level rise and the effects of climate change impacts on the availability and quality of these resources can result in tourism and revenue loss

(USGCRP 2014). Changes or fluctuations in sea levels, storm surges, erosion, and sedimentation could affect port operations and the economic activities that ports support. In 2016, Port Miami contributed approximately $1.3 billion in State and local taxes, supported approximately 324,400 jobs (including direct, indirect, and induced jobs) as a result of cargo and cruise activity, and saw approximately 5.3 million passengers pass through its portals (Port Miami 2017). Additionally, most of the petroleum products consumed by Florida are delivered by barge to ports (USGCRP 2009). Rising sea levels and extreme weather events can damage roads and coastal infrastructure. Property values are also vulnerable to sea level rise; studies indicate that properties in lower elevations sell for less or gain in value more slowly than those located in higher elevations (Keenan et al. 2018, Bernstein et al. 2017). Therefore, climate changes in the ROI could result in adverse socioeconomic and transportation impacts.

4.16.6 Historic and Cultural Resources

As described in Section 4.9, "Historic and Cultural Resources," of this SEIS, historic structures and properties within the area of potential effect are not likely to be adversely affected by subsequent license renewal-related activities since the site area has low historical, cultural and archeological potential, and no ground-disturbing activities or physical changes would occur at Turkey Point during the subsequent license renewal term beyond ongoing maintenance activities. As discussed in Section 4.9, FPL has administrative controls on how to handle unanticipated historical and cultural finds related to potential ground-disturbing activities. Additionally, FPL provides training sessions to Turkey Point staff to ensure that plant personnel consider cultural resources during planned maintenance activities.

As described in Section 3.9, "Historic and Cultural Resources," of this SEIS, the geographic area considered in this analysis is the area of potential effect associated with the proposed undertaking (subsequent license renewal for Turkey Point Units 3 and 4). In the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG-2176), Table 7-1 summarizes present and reasonably foreseeable future actions that could affect historic properties at the Turkey Point site. Direct impact would occur if historic and cultural resources in the area of potential effect were physically removed or disturbed. For instance, the potential expansion of the ISFSI, the construction of a wastewater treatment facility, and the expansion of roads (transportation projects) could have direct impacts on cultural resources through inadvertent discovery during ground-disturbing activities or result in new above-ground structures that affect the visual area of potential effect. However, reasonable onsite activities conducted on the Turkey Point site could avoid the areas where historic structures, such as the McGregor Smith Cottage, are located. As discussed in Section 4.9.1.3, "Findings," based on cultural resource surveys, the Turkey Point site has a low archeological potential. Additionally, FPL has administrative controls in place on how to handle unanticipated historical and cultural finds related to potential ground-disturbing activities.

Changes or fluctuations in sea levels because of climate change could result in the disturbance or loss of terrestrial historic and cultural resources from flooding, increased erosion, or inundation of shorelines and surrounding areas. As discussed in Section 4.15.3.2, "Climate Change," of this SEIS, sea level is projected to continue to rise. Because of water-level changes, historic and cultural resources could be lost before they could be documented or studied. Rising sea levels, loss of land, and changes in temperature can affect the availability and access to local plant and animal species, thereby impacting the tribal communities who have historically depended on them for food or medicine (USGCRP 2014).

4.16.7 Human Health

The NRC and EPA have established radiological dose limits to protect the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are in 10 CFR Part 20, "Standards for Protection Against Radiation," and 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." As discussed in Section 4.11, "Human Health," of this SEIS, the impacts to human health from continued plant operations during the subsequent license renewal term are SMALL. For the purposes of this cumulative impacts analysis, the geographical area considered is the area within a 50-mi (80-km) radius of Turkey Point Units 3 and 4. There are no other nuclear power plants within this 50-mi (80-km) radius. However, that radius does overlap with the 50-mi (80-km) radius around proposed Turkey Point Units 6 and 7, which would be sited directly adjacent to Turkey Point Units 3 and 4. As discussed in Section 3.1.4.4, "Radioactive Waste Storage," of this SEIS, FPL stores spent nuclear fuel from Units 3 and 4 in a storage pool and in an onsite independent spent fuel storage installation (ISFSI). As a reasonably foreseeable future project, FPL has stated that if the U.S. Department of Energy (DOE) does not take ownership of onsite commercial spent nuclear fuel by 2031, FPL may need to expand the Turkey Point Units 3 and 4 ISFSI storage capability to account for the additional spent nuclear fuel generated during the subsequent license renewal term.

Another reasonably foreseeable future action with the potential to contribute to cumulative radiological impacts is the proposed construction and operation of two new nuclear units (Turkey Point Units 6 and 7) at the Turkey Point site. The operation of Turkey Point Units 6 and 7 would result in radiological releases and dose impacts to workers and the public, in addition to the impacts resulting from operation of Units 3 and 4. Also, spent fuel would accumulate onsite as a result of the operation of Units 6 and 7, in addition to the spent fuel produced by operation of Units 3 and 4. Sections 5.93, "Impacts on Members of the Public," 5.94, "Occupational Doses to Workers," and 6.1.6, "Radiological Wastes," of the NRC staff's EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176) (NRC 2016a) describe those impacts in detail. The NRC staff incorporates those impact analyses from NUREG–2176 into this SEIS by reference.

EPA regulations in 40 CFR Part 190 limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.1.4.5 in this SEIS, FPL has a radiological environmental monitoring program (REMP) that measures radiation and radioactive materials in the environment from Turkey Point Units 3 and 4, its ISFSI, and all other sources. The NRC staff reviewed the radiological environmental monitoring results for the 5-year period from 2013 through 2017 as part of this cumulative impacts assessment. The review of FPL's data showed no indication of an adverse trend in radioactivity levels in the environment from either Turkey Point Units 3 and 4 or the ISFSI. The data showed that there was no measurable impact to the environment from operations at Turkey Point Units 3 and 4. Also, since the proposed Units 6 and 7 would operate under the same State and Federal regulatory standards as Units 3 and 4, there would be no significant impact on the environment from the operation of the proposed Turkey Point Units 6 and 7.

In summary, the NRC staff concludes that there is no significant cumulative effect on human health resulting from the proposed action of subsequent license renewal, in combination with cumulative impacts from other sources. The NRC staff bases this conclusion on its review of radiological environmental monitoring program data, radioactive effluent release data, worker dose data; the expectation that Turkey Point Units 3 and 4 would continue to comply with

Federal radiation protection standards during the period of extended operation; and the continued regulation of any future development or actions in the vicinity of the Turkey Point site (including proposed Turkey Point Units 6 and 7) by the NRC and the State of Florida.

4.16.8 Environmental Justice

The environmental justice cumulative impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from past, present, and reasonably foreseeable future actions, including the continued operational effects of Turkey Point Units 3 and 4 during the subsequent license renewal term. The geographic area of interest for this environmental justice cumulative impact analysis is the area within a 50-mi (80-km) radius of Turkey Point. As discussed in Section 4.12, “Environmental Justice,” of this SEIS, there would be no disproportionately high and adverse impacts on minority and low-income populations from the continued operation of Turkey Point Units 3 and 4 during the subsequent license renewal term.

Contributory cumulative effects could come from the other reasonably foreseeable future planned activities at or near the Turkey Point site that are unrelated to the proposed action (subsequent license renewal), as well as from other reasonably foreseeable planned offsite activities. Potential impacts to minority and low-income populations from the construction and operation of proposed reactors Turkey Point Units 6 and 7 would mostly consist of certain localized environmental effects (such as noise, air emissions, traffic, and housing impacts). However, the NRC staff did not identify any disproportionately high and adverse impacts on minority and low-income populations that would occur as a result of the construction and operation of the proposed Turkey Point Units 6 and 7. Transportation projects can have disproportionately high and adverse impacts on minority and low-income populations if the projects bisect any minority or low-income neighborhoods, require the displacement of residences in those neighborhoods, or result in minority or low-income populations disproportionately bearing the effects of the project.

Changes in climate conditions could disproportionately affect minority and low-income populations. The U.S. Global Change Research Program (USGCRP 2009) states that “people living in poverty are especially at risk from a variety of climate-related health effects.” The greatest health burdens are likely to fall on the poor, especially those lacking adequate shelter and access to resources such as air conditioning (USGCRP 2014a). Climate change could affect the availability and access to local plant and animal species, thereby impacting the tribal communities that have historically depended on them for food or medicine (USGCRP 2014). In coastal regions, social and cultural disparities vary regionally and social factors (i.e., low-income, minority status, educational achievement) can limit the ability of some people to adapt to changing environmental conditions caused by climate change. This can result in the displacement of vulnerable minority and low-income populations and lead to social disruption. As discussed in Section 4.15.3 of this SEIS, climate change can result in decreases in water availability and water quality as a result of saltwater intrusion into coastal fresh groundwater supplies. This has significant implications for Miami-Dade County’s public water supply systems as well as for private and industrial users of groundwater aquifers. As discussed in Section 3.10.3, according to the 2010 Census (USCB 2010a), minorities (race and ethnicity combined) comprised approximately 85 percent of the total population in Miami-Dade County. Therefore, climate change effects on groundwater availability and quality would be disproportionately borne by the minority populations that Miami-Dade County water treatment plants serve.

4.16.9 Waste Management and Pollution Prevention

This section describes waste management impacts during the subsequent license renewal term when combined with the aggregate effects of other past, present, and reasonably foreseeable future actions. For the purpose of this cumulative impacts analysis, the NRC staff considered the area within a 50-mi (80-km) radius of Turkey Point. In Section 4.11, “Human Health,” the NRC staff concluded that the potential human health impacts from Turkey Point’s waste during the subsequent license renewal term would be SMALL.

As discussed in Sections 3.1.4 and 3.1.5 of this SEIS, FPL maintains waste management programs for radioactive and nonradioactive waste generated at Turkey Point Units 3 and 4 and is required to comply with Federal and State permits and other regulatory waste management requirements. The nuclear power plants and other facilities within a 50-mi (80-km) radius of Turkey Point Units 3 and 4 are also required to comply with appropriate NRC, EPA, and State requirements for the management of radioactive and nonradioactive waste. Current waste management activities at Turkey Point Units 3 and 4 would likely remain unchanged during the subsequent license renewal term, and the NRC staff expects that FPL will continue to comply with Federal and State requirements for radioactive and nonradioactive waste.

Due to the comprehensive regulatory controls in place for management of radioactive waste, FPL’s compliance with these regulations, and its use of licensed treatment and disposal facilities, the impacts of radioactive waste are expected to be SMALL during the subsequent license renewal term. There are no other operating nuclear power plants, fuel-cycle facilities, or radiological waste treatment and disposal facilities within a 50-mi (80-km) radius of Turkey Point. There are industrial, medical, and research facilities in the region that use radioactive materials. The NRC staff’s EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176, Volume 1, Section 7.8) (NRC 2016a) analyzed the cumulative impacts of managing radioactive waste within a 50-mi (80-km) radius of Turkey Point and determined the cumulative impact to be SMALL. The NRC staff likewise expects that the cumulative impact of radioactive waste management, including the impacts from Turkey Point subsequent license renewal, will be SMALL, given the regulatory controls in place for radioactive waste treatment and disposal, FPL’s established waste management practices, and its use of licensed treatment and disposal facilities.

Continued operation of Turkey Point would have a small impact on nonradioactive waste management facilities given FPL’s program for waste management and the availability of treatment and disposal facilities. The NRC staff’s EIS for the Turkey Point Units 6 and 7 combined licenses (NUREG–2176, Volume 1, Section 7.9) analyzed the cumulative impacts of nonradioactive waste from past, present, and future projects in the geographic area of interest of Miami-Dade County. The EIS concluded that the cumulative impacts from nonradioactive waste management would be SMALL. The NRC staff expects that FPL would continue its programs of waste management and will continue to comply with its permits and waste management regulations. Given that facilities within Miami-Dade County are also required to comply with appropriate EPA and state requirements for the management of hazardous and nonhazardous waste, and that state and local authorities would ensure that FPL continues to comply with regulations governing waste management, the cumulative impact of nonradioactive waste management would be small.

The additional 20 years of spent nuclear fuel generated during the subsequent license renewal term would be stored in the spent fuel pools until adequately cooled and then transferred to dry storage in an ISFSI. The Turkey Point onsite ISFSI is licensed under the general license provided to power reactor licensees under 10 CFR 72.210. The NRC oversight of onsite spent fuel storage ensures that the increased volume in onsite storage can be safely accommodated with little environmental effect. No new and significant information has been identified for this issue; therefore, no further analysis is required. The issue was also considered for Turkey Point's initial license renewal environmental review, and no new and significant information was found at that time (NRC 2002c).

In summary, the NRC staff concludes that there would be no significant cumulative effect from the generation of radioactive and nonradioactive waste during the period of extended operation authorized by the proposed action of subsequent license renewal. The NRC staff bases its conclusion on the continued compliance of FPL with Federal and State of Florida requirements for radioactive and nonradioactive waste management and on the expected regulatory compliance of other waste producers in the area.

4.16.10 Global Greenhouse Gas Emissions

The cumulative impact of a greenhouse gas emission source on climate is global. Greenhouse gas emissions are transported by wind and become well mixed in the atmosphere as a result of their long atmospheric residence time. Therefore, the extent and nature of climate change is not specific to where greenhouse gases are emitted. Due to the global significance of greenhouse gas emissions, a global climate change cumulative impacts analysis inherently considers the entire Earth's atmosphere and, therefore, emissions on a global scale (as opposed to simply those emissions on a county, State, or national scale). As discussed in Section 4.15.3.2, "Climate Change," of this SEIS, climate change and climate-related environmental changes have been observed on a global level, and climate models indicate that future climate change will depend on present and future global greenhouse gas emissions. Climate models indicate that short-term climate change (through the year 2030) is dependent on past greenhouse gas emissions. Therefore, short-term climate change is projected to occur with or without present and future greenhouse gas emissions from Turkey Point. Beyond the short term, climate models indicate that with continued increases in global greenhouse gas emission rates the Earth's average surface temperature will continue to increase and climate-related changes will persist.

In April 2018, EPA published its latest Greenhouse Gas Inventory report, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2016." As the official U.S. inventory of greenhouse gas emissions, this EPA report identifies and quantifies the primary anthropogenic sources (those human caused or produced) and sinks of greenhouse gases. The Greenhouse Gas Inventory is an essential tool for addressing climate change and for participating with the United Nations Framework Convention on Climate Change to compare the relative global contribution of different emission sources and greenhouse gases to climate change. In 2016, the United States emitted 6,511.3 million metric tons (MMT) of $CO_{2eq.}$ From 1990 to 2016, emissions increased by 2.4 percent. However, from 2015 to 2016, emissions decreased by 1.9 percent. Across the United States, emissions attributable to electricity generation totaled 1,809.3 MMT of CO_{2eq} (EPA 2018c). The Energy Information Administration (EIA) reported that in 2015, Florida's electric power sector was responsible for 107.6 MMT of CO_{2eq} (EIA 2018e).

Facilities that emit 25,000 MT CO_{2eq} or more per year are required to annually report their greenhouse gas emissions to the EPA. These facilities are known as direct emitters, and the data are publicly available in EPA's facility-level information on greenhouse gases tool (FLIGHT). In 2016, FLIGHT-identified facilities in Florida emitted a total of 134 MMT of $CO_{2eq.}$ Facilities in Miami-Dade County emitted a total of 4.95 MMT of CO_{2eq} (EPA 2018d).

Section 4.16, "Cumulative Impacts," of this SEIS references current and reasonably foreseeable future projects and actions that could contribute to greenhouse gas emissions. Permitting and licensing requirements and other mitigative measures can minimize the impacts of greenhouse gas emissions. For instance, in 2012, EPA issued a final Greenhouse Gas Tailoring Rule (77 FR 41051) to address greenhouse gas emissions from stationary sources under the Clean Air Act permitting requirements. The Greenhouse Gas Tailoring Rule establishes when an emission source will be subject to permitting requirements and control technology to reduce greenhouse gas emissions.

EPA's Greenhouse Gas Inventory illustrates the diversity of greenhouse gas sources, which include electricity generation (including fossil fuel combustion and incineration of waste), industrial processes, and agriculture. As presented in Section 4.15.3.1, "Greenhouse Gas Emissions and Climate Change," of this SEIS, annual direct greenhouse gas emissions from combustion sources resulting from ancillary operations at Turkey Point range from 3,550 to 3,810 MT of CO_{2eq}. In comparing Turkey Point's greenhouse gas emission to total U.S. greenhouse gas emissions, emissions from electricity production in Florida, or emissions on a county level, greenhouse gas emissions from Turkey Point are relatively minor. When compared to global emissions, greenhouse gas emissions associated with Turkey Point Units 3 and 4 operations are negligible (see Table 4-8 below). Furthermore, as presented in Table 4-7, "Direct Greenhouse Gas Emissions from Facility Operations Under the Proposed Action and Alternatives," in Section 4.15.3.1, the natural gas and combination alternatives' annual greenhouse gas emissions are higher by several orders of magnitude than those from the continued operation of Turkey Point Units 3 and 4. If Turkey Point's generating capacity were to be replaced by other non-nuclear power generating alternatives evaluated in this SEIS, there would be an increase in greenhouse gas emissions. Consequently, the NRC staff concludes that the continued operation of Turkey Point through the subsequent license renewal period (the proposed action) would result in greenhouse gas emissions avoidance. In other words, when compared to alternative baseload replacement power generation sources considered in this SEIS, the continued operations of Turkey Point Units 3 and 4 would have a net, beneficial contribution to greenhouse gas emissions and climate change impacts during the subsequent license renewal term.

Table 4-8 Comparison of Greenhouse Gas Emission Inventories

Source	CO_{2eq} MMT/year
Global Emissions (2016) [a]	37,000
U.S. Emissions (2016)[b]	6,511
Florida (2016)[c]	134
Miami-Dade County, Florida (2016)[c]	4.95
Turkey Point [d]	3.8×10^{-3}

[a] Carbon dioxide emissions obtained from the Global Carbon Project (GCP 2018) and converted to carbon dioxide equivalents (CO_{2eq}).

[b] Source: EPA 2018c.

[c] Greenhouse gas emissions account only for direct emitters, those facilities that emit 25,000 MT or more a year (EPA 2018d).

[d] Peak emissions over the last 5 years from FPL 2018f.

Source: GCP 2018, EPA 2018c, EPA 2018d, FPL 2018f

4.17 Resource Commitments Associated with the Proposed Action

This section describes the NRC staff's consideration of potentially unavoidable adverse environmental impacts that could result from the implementation of the proposed action (subsequent license renewal) and alternatives to the proposed action, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and the irreversible and irretrievable commitments of resources.

4.17.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out any of the replacement energy alternatives considered in this SEIS, including the proposed action of subsequent license renewal for Turkey Point Units 3 and 4, would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur due to emission and release of various chemical and radiological constituents from power plant operations. Non-radiological emissions resulting from power plant operations are expected to comply with EPA emissions standards, although the alternative of operating a fossil-fueled power plant in some areas may worsen existing attainment issues. Chemical and radiological emissions would not exceed the national emission standards for hazardous air pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to minor levels of radiation as well as to hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and would not exceed regulatory standards or administrative control limits. In comparison, the alternatives involving the construction and operation of a non-nuclear power generating facility would also result in unavoidable exposure to hazardous and toxic chemicals to workers and the public.

The generation of spent nuclear fuel and waste material—including low-level radioactive waste, hazardous waste, and nonhazardous waste—would be unavoidable. Non-nuclear power generating facilities would generate both hazardous and nonhazardous waste. For wastes generated during operations, power plant operators would collect, store, and ship these for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Due to the costs of handling these materials, the NRC staff expects that power plant operators would optimize all waste management activities and operations in a way that generates the smallest possible amount of waste.

4.17.2 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment, as described in Chapter 4, "Environmental Consequences and Mitigating Actions," of this SEIS. Short term is the period of time that continued power generating activities take place.

Power plant operations require short-term use of the environment and commitment of resources (e.g., land and energy), indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including subsequent license renewal, than under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from nuclear power plant operations introduce small amounts of radiological and non-radiological emissions to the region around the plant site. Over time, these emissions would result in increased concentrations and exposure, but the NRC staff does not expect that these emissions would impact air quality or radiation exposure to the extent that they would impair public health and long-term productivity of the environment.

Continued employment, expenditures, and tax revenues generated during power plant operations directly benefit local, regional, and State economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste requires an increase in energy and consumes space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Power plant facilities are committed to electricity production over the short term. After decommissioning these facilities and restoring the area, the land could be available for other future productive uses.

4.17.3 Irreversible and Irretrievable Commitment of Resources

Resource commitments are irreversible when primary or secondary impacts limit the future options for a resource. For example, the consumption or loss of nonrenewable resources are irreversible. An irretrievable commitment refers to the use or consumption of resources for a period of time (e.g., for the duration of the action under consideration) that are neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and man-made resources required for power plant operations. In general, the commitments of capital, energy, labor, and material resources are also irreversible.

The implementation of any of the replacement energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, and—in some cases—fossil fuels. These resources would be committed during the subsequent license renewal term and over the entire life cycle of the power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and power plant operations and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems. These resources are readily available, and the NRC staff does not expect that the required amounts would deplete available supplies or exceed available system capacities.

5 CONCLUSION

This draft supplemental environmental impact statement (SEIS) contains the NRC staff's environmental review of Florida Power & Light Company's (FPL's) application for subsequent renewed operating licenses for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4), as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The regulations at 10 CFR Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.). This chapter briefly summarizes the environmental impacts of Turkey Point subsequent license renewal, lists and compares the environmental impacts of alternatives to subsequent license renewal, and presents the NRC staff's conclusions and recommendation.

5.1 Environmental Impacts of Subsequent License Renewal

After reviewing new and potentially significant information with respect to two generic (Category 1) environmental issues in this SEIS, the NRC staff concluded that issuing subsequent renewed licenses for Turkey Point would not have impacts beyond those discussed in the NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC 2013a).

After reviewing the site-specific (Category 2) environmental issues and one new uncategorized issue in this SEIS, the NRC staff concluded that issuing subsequent renewed licenses for Turkey Point would have SMALL impacts for the Category 2 issues and the new uncategorized issue applicable to subsequent license renewal at Turkey Point, with two exceptions: (1) for groundwater resources, the impact would be SMALL to MODERATE, and (2) for aquatic resources, the impact would be SMALL to MODERATE. The NRC staff considered mitigation measures for each issue, as applicable. The NRC staff concluded that no additional mitigation measure is warranted.

5.2 Comparison of Alternatives

In Chapter 4, "Environmental Consequences and Mitigating Actions," of this SEIS, the NRC staff considered the following alternatives to issuing subsequent renewed licenses to Turkey Point:

- no-action alternative
- new nuclear alternative
- natural gas combined-cycle alternative
- combination alternative of natural gas combined-cycle and solar photovoltaic

The staff also evaluated a cooling water system alternative using mechanical draft cooling towers instead of the Cooling Canal System (CCS) for cooling the Turkey Point Units 3 and 4 reactors.

Based on the evaluation presented in this draft SEIS, the NRC staff concludes that the environmentally preferred alternative is the proposed action of subsequent license renewal for Turkey Point Units 3 and 4. As shown in Table 2-2, "Summary of Environmental Impacts of the Proposed Action and Alternatives," all reasonable power-generation alternatives have impacts in at least two resource areas that are greater than the impacts of subsequent license renewal, in addition to the environmental impacts inherent with new construction projects.

5.3 Preliminary Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Turkey Point are not so great that preserving the option of subsequent license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff bases this recommendation on the following:

- the analysis and findings in NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by FPL
- the NRC staff's consultation with Federal, State, Tribal, and local government agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comments

6 REFERENCES

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10 CFR Part 20. *Code of Federal Regulations*, Title 10, Energy, Part 20, "Standards for Protection against Radiation."

10 CFR Part 50. *Code of Federal Regulations*, Title 10, Energy, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

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10 CFR Part 100. *Code of Federal Regulations*, Title 10, Energy, Part 100, "Reactor Site Criteria."

36 CFR Part 60. *Code of Federal Regulations*, Title 36, Parks, Forests, and Public Property, Part 60, "National Register of Historic Places."

36 CFR Part 800. *Code of Federal Regulations*, Title 36, Parks, Forests, and Public Property, Part 800, "Protection of Historic Properties."

40 CFR Part 50. *Code of Federal Regulations*, Title 40, Protection of Environment, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. *Code of Federal Regulations*, Title 40, Protection of Environment, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

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7 LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Reactor Regulation (NRR) prepared this supplemental environmental impact statement with assistance from other NRC organizations and support from Pacific Northwest National Laboratory. Table 7-1 below identifies each contributor's name, affiliation, and function or expertise.

Table 7-1 List of Preparers

Name	Education/Experience	Function or Expertise
	NRC Staff (in alphabetical order)	
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Phyllis Clark	M.S. Nuclear Engineering; M.B.A, Business Administration; B.S. Physics; 35 years of industry and Government experience including nuclear power plant and production reactor operations, systems engineering, reactor engineering, fuels engineering, criticality, power plant emergency response	Radiological and Waste Management
Jerry Dozier	M.S. Reliability Engineering; M.B.A. Business Administration; B.S. Mechanical Engineering; 30 years of experience including operations, reliability engineering, technical reviews	Severe Accident Mitigation Alternative (SAMA)
David Drucker	M.S. Engineering Management; B.S. General Engineering; 37 years managing projects	Project Management
Kevin Folk	M.S. Environmental Biology; B.A. Geoenvironmental Studies; 29 years of experience in NEPA compliance; geologic, hydrologic, and water quality impacts analysis; utility infrastructure analysis, environmental regulatory compliance; and water supply and wastewater permitting	Groundwater; Greenhouse Gas Emissions and Climate Change
William Ford	M.S. Geology; 44 years of combined industry and Government experience working on groundwater, surface water, and geology projects	Geology; Surface Water
Briana Grange	Masters Certification - National Environmental Policy Act; B.S. Conservation Biology; 13 years of experience in environmental impact analysis, Section 7 consultations, and essential fish habitat consultations	Aquatic Resources; Terrestrial Resources; Special Status Species and Habitats; Microbiological Hazards
Robert Hoffman	B.S. Environmental Resource Management; 33 years of experience in NEPA	Alternatives; Meteorology and Air Quality

Name	Education/Experience	Function or Expertise
	compliance, environmental impact assessment, alternatives identification and development, and energy facility siting	
Lois James	M.S. Environmental Engineering; B.S. Nuclear Engineering; 27 years of combined industry and Government experience including power plant inspection, power plant incident response, and project management	Project Management
Nancy Martinez	B.S. Earth and Environmental Science; A.M. Earth and Planetary Science; 8 years of experience in environmental impact analysis	Historic and Cultural Resources; Socioeconomics; Environmental Justice
Michelle Moser	M.S. Biological Sciences; B.S. Environmental Sciences; 17 years of experience in ecological studies, environmental impact assessment, and protected resource management	Terrestrial Resources
William Rautzen	M.S. Health Physics; B.S. Health Physics; B.S. Industrial Hygiene; 9 years of experience in environmental impact analysis	Human Health
Jeffrey Rikhoff	M.R.P. Regional Planning, M.S. Economic Development and Appropriate Technology; 38 years of combined industry and Government experience including 31 years of NEPA compliance, socioeconomics and environmental justice impact analyses, cultural resource impact assessments, consultations with American Indian tribes, and comprehensive land-use and development planning studies	Land Use, Noise, and Cumulative Impacts Introduction
Pacific Northwest National Laboratory Staff (in alphabetical order)		
Philip Meyer	Ph.D. Civil Engineering; B.A. Physics; 27 years relevant experience in subsurface hydrology and contaminant transport	Groundwater Resources
Terri Miley	M.S. Mathematics; B.S. Mathematics; 13 years relevant experience in NEPA comment-response and database development	Comment Response Support Lead
Rajiv Prasad	Ph.D. Civil and Environmental Engineering; M. Tech. Civil Engineering; B.S. Civil Engineering; 15 years relevant experience in surface water use and quality characterization and assessment	Surface Water Resources
James Saulsbury	M.S. Planning; B.A. History; 31 years relevant experience in land use and socioeconomic impact assessment	Pacific Northwest National Laboratory Team Lead
Paul Thorne	M.S. Hydrology; B.S. Chemistry/Math; 34 years relevant experience in hydrogeology including analysis of groundwater flow and migration of contaminants in the subsurface	Groundwater Resources

8 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS SEIS ARE SENT

Table 8-1 List of Agencies, Organizations, and Persons to Whom Copies of this SEIS Are Sent

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APPENDIX A
COMMENTS RECEIVED ON THE TURKEY POINT NUCLEAR GENERATING UNITS 3 AND 4 ENVIRONMENTAL REVIEW

A.1 Comments Received During the Scoping Period

The scoping process for the environmental review of the Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4) subsequent license renewal began in May 2018, in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) (NEPA). On May 14, 2018, the U.S. Nuclear Regulatory Commission (NRC) issued a notice of intent to prepare an environmental impact statement and conduct an environmental scoping process for subsequent license renewal of Turkey Point; that notice was published in the *Federal Register* on May 14, 2018 (83 FR 23726). The scoping process included two public meetings held in Homestead, FL, on May 31, 2018. The NRC issued a press release and purchased newspaper advertisements to advertise the two public meetings. In addition to participation by the applicant, Florida Power & Light Company (FPL), and local officials, several members of the public attended the meetings. After the NRC staff presented prepared statements on the subsequent license renewal process, the staff opened the meetings for public comments. Attendees were provided the opportunity to make oral statements that were recorded and transcribed by a certified court reporter. A summary and transcripts of the scoping meetings are available in the NRC's Agencywide Documents Access and Management System (ADAMS). The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams.html. The scoping meetings summary is available at ADAMS Accession No. ML18176A404. The transcripts of the meetings are available at ADAMS Accession No. ML18176A399 for the afternoon session and No. ML18176A401 for the evening session. In addition to comments received during the public meetings, comments were also received electronically and through the mail.

The NRC received numerous comments during the scoping process which identified many important issues that were addressed by the NRC staff in this draft supplemental environmental impact statement (SEIS) for Turkey Point's subsequent license renewal. The scoping summary report provides the NRC staff's responses to comments received as part of the Turkey Point environmental scoping process and is available at ADAMS Accession No. ML18342A014.

APPENDIX B
APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

There are a number of Federal laws and regulations that affect environmental protection, health, safety, compliance, and consultation at every NRC-licensed nuclear power plant. Some of these laws and regulations require permits from or consultations with other Federal agencies or State, Tribal, or local governments. Certain Federal environmental requirements have been delegated to State authorities for enforcement and implementation. Furthermore, States have also enacted their own laws to protect public health and safety and the environment. It is the NRC's policy to make sure nuclear power plants are operated in a manner that provides adequate protection of public health and safety and protection of the environment through compliance with applicable Federal and State laws, regulations, and other requirements.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.) (AEA), authorizes the NRC to enter into an agreement with any State that allows the State to assume regulatory authority for certain activities (see 42 U.S.C. 2021). Florida has been an NRC Agreement State since 1964, and the Bureau of Radiation Control within the Florida Department of Health has regulatory responsibility over the radioactive materials program as it is carried out under the AEA Section 274b Agreement between the NRC and the State of Florida (FDOH 2018b).

In addition to carrying out some Federal programs, State legislatures develop their own laws. State statutes can supplement, as well as implement, Federal laws for protection of air, surface water, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The U.S. Environmental Protection Agency (EPA) has the primary responsibility to administer the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., herein referred to as the Clean Water Act (CWA)). The National Pollutant Discharge Elimination System (NPDES) program addresses water pollution by regulating the discharge of potential pollutants to waters of the United States. EPA allows for primary enforcement and administration through State agencies, as long as the State program is at least as stringent as the Federal program.

The EPA has delegated the authority to issue NPDES permits to the State of Florida. The Florida Department of Environmental Protection (FDEP) provides oversight for public water supplies, issues permits to regulate the discharge of industrial and municipal wastewaters—including discharges to groundwater—and monitors State water resources for water quality. The FDEP issues NPDES permits to regulate and control water pollutants.

B.1 Federal and State Requirements

Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4) is subject to various Federal and State requirements. Table B-1 lists the principal Federal and State regulations and laws that are used or mentioned in this supplemental environmental impact statement (SEIS) for Turkey Point.

Table B-1 Federal and State Requirements

Law/regulation	Requirements
	Current operating license and subsequent license renewal
Atomic Energy Act, 42 U.S.C. 2011 et seq.	The Atomic Energy Act of 1954, as amended (AEA), and the Energy Reorganization Act of 1974, as amended (42 U.S.C. 5801 et seq.), give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, “Energy,” of the *Code of Federal Regulations* (10 CFR).
10 CFR Part 2	Regulations in 10 CFR Part 2, “Agency Rules of Practice and Procedure,” govern the conduct of all proceedings (other than export and import licensing proceedings) for: (a) granting, suspending, revoking, amending, or taking other action with respect to any license, construction permit, or application to transfer a license, (b) issuing orders and demands for information to persons subject to the Commission's jurisdiction, including licensees and persons not licensed by the Commission, (c) imposing civil penalties under AEA Section 234, (d) rulemaking under the AEA and the Administrative Procedure Act, and (e) standard design approvals under 10 CFR Part 52.
10 CFR Part 20	Regulations in 10 CFR Part 20, “Standards for Protection Against Radiation,” establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the AEA and the Energy Reorganization Act of 1974, as amended. The purpose of these regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in 10 CFR Part 20.
10 CFR Part 50	Regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” provide for the licensing of production and utilization facilities, including power reactors.
10 CFR Part 51	Regulations in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” implement Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA).
10 CFR Part 54	Regulations in 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” govern the issuance of renewed operating licenses and renewed combined licenses for nuclear power plants licensed pursuant to Sections 103 or 104b of the AEA, as amended, and Title II of the Energy Reorganization Act of 1974. The regulations focus on managing adverse effects of aging and are intended to ensure that important systems, structures, and components will continue to perform their intended functions during the period of extended operation.
10 CFR Part 100	Regulations in 10 CFR Part 100, “Reactor Site Criteria,” establish approval requirements for proposed sites for stationary power and testing reactors.

Law/regulation	Requirements
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq. (NEPA)	NEPA requires Federal agencies to integrate environmental values into their decisionmaking process by considering the environmental impacts of proposed Federal actions and reasonable alternatives to those actions. NEPA establishes policy and sets goals (in Section 101) and provides means for carrying out the policy and goals (in Section 102). NEPA Section 102(2) contains action-forcing provisions to ensure that Federal agencies follow the letter and spirit of the act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the act requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.
40 CFR Part 50	Regulations in 40 CFR Part 50, “National Primary and Secondary Ambient Air Quality Standards,” establish the following: (1) national primary ambient air quality standards that define levels of air quality which the EPA judges are necessary to protect the public health and (2) national secondary ambient air quality standards that define levels of air quality which the EPA judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
40 CFR Part 51	Regulations in 40 CFR Part 51, “Requirements for Preparation, Adoption, and Submittal of Implementation Plans,” include § 51.308, “Regional haze program requirements” (referred to as the Regional Haze Rule), which establishes requirements for implementation plans, plan revisions, and periodic progress reviews to address regional haze.
40 CFR Part 60	Regulations in 40 CFR Part 60, “Standards of Performance for New Stationary Sources,” contain emissions guidelines and standards of performance for new stationary sources.
40 CFR Part 63	Regulations in 40 CFR Part 63, “National Emission Standards for Hazardous Air Pollutants for Source Categories,” contain national emission standards for hazardous air pollutants (NESHAP) established pursuant to Section 112 of the Clean Air Act, that regulate specific categories of stationary sources that emit (or have the potential to emit) one or more hazardous air pollutants listed in this part.
40 CFR Part 81	Regulations in 40 CFR Part 81, “Designation of Areas for Air Quality Planning Purposes,” designate Air Quality Control Regions (Subpart B), list the standards attainment status by state areas (Subpart C), and identify Mandatory Class I Federal Areas Where Visibility is an Important Value (Subpart D).
40 CFR Part 110	Regulations in 40 CFR Part 110, “Discharge of Oil,” establish regulations applicable to the discharge of oil prohibited by Section 311(b)(3) of the CWA.
40 CFR Part 112	Regulations in 40 CFR Part 112, “Oil Pollution Prevention,” establish procedures, methods, equipment, and other requirements to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable waters of the United States or adjoining shorelines.
40 CFR Part 125	Regulations in 40 CFR Part 125, “Criteria and Standards for the National Pollutant Discharge Elimination System,” establish criteria and standards for the imposition of technology-based treatment requirements in permits under Section 301(b) of the CWA, including the application of EPA-promulgated effluent limitations and case-by-case determinations of effluent limitations under Section 402(a)(1) of the CWA.
40 CFR Part 131	Regulations in 40 CFR Part 131, “Water Quality Standards,” contain requirements and procedures for developing, reviewing, revising, and approving water quality standards by the States as authorized by Section 303(c) of the CWA.
40 CFR Part 141	Regulations in 40 CFR Part 141, “National Primary Drinking Water Regulations,” establish primary drinking water regulations pursuant to Section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act.

Law/regulation	Requirements
40 CFR Part 143	Regulations in 40 CFR Part 143, "National Secondary Drinking Water Regulations," establish National Secondary Drinking Water Regulations pursuant to Section 1412 of the Safe Drinking Water Act.
40 CFR Part 190	Regulations in 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," establish limits for radiation dose equivalent to the public and the total quantity of radioactive materials entering the environment from the entire uranium fuel cycle.
Air quality protection	
Clean Air Act, 42 U.S.C. 7401 et seq.	The Clean Air Act (CAA) is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." The CAA establishes regulations to ensure maintenance of air quality standards and authorizes individual States to manage permits. Section 109 of the CAA directs the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for criteria pollutants. The EPA has identified and set NAAQS for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the CAA requires the establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Section 161 of the CAA requires that specific emission increases must be evaluated before permit approval to prevent significant deterioration of air quality. Section 112 requires specific standards for release of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. Nuclear power plants may be required to comply with the CAA Title V, Sections 501–507, for sources subject to new source performance standards or sources subject to National Emission Standards for Hazardous Air Pollutants. EPA regulates the emissions of air pollutants using 40 CFR Parts 50 to 99.

Law/regulation	Requirements
	Water resources protection
Clean Water Act, 33 U.S.C. 1251 et seq., and the National Pollutant Discharge Elimination System (NPDES) (40 CFR Part 122)	The Clean Water Act (CWA) was enacted to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” As authorized by the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program requires all facilities that discharge pollutants from any point source into waters of the United States to obtain an NPDES permit. A nuclear power plant may also participate in the NPDES General Permit for Industrial Stormwater due to stormwater runoff from industrial or commercial facilities to waters of the United States. EPA is authorized under the CWA to directly implement the NPDES program; however, EPA has authorized many States to implement all or parts of the national program. Section 401 of the CWA requires applicants for federal permits or licenses for a facility that may discharge into navigable waters to provide a certification from the State that the permitted discharge would comply with all limitations necessary to meet established State water quality standards, treatment standards, or schedule of compliance. The U.S. Army Corps of Engineers (USACE) is the lead agency for enforcement of CWA wetland requirements (33 CFR Part 320, “General Regulatory Policies”). Under Section 401 of the CWA, the EPA or a delegated State agency has the authority to review and approve, condition, or deny all permits or licenses that might result in a discharge to waters of the State, including wetlands.
Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.	Congress enacted the Coastal Zone Management Act (CZMA) in 1972 to address the increasing pressures of over-development upon the Nation’s coastal resources. The National Oceanic and Atmospheric Administration administers the Act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary. To encourage States to participate, the CZMA makes Federal financial assistance available to any coastal State or territory, including those on the Great Lakes, as long as the State or territory is willing to develop and implement a comprehensive coastal management program.
FAC 62-296	Florida Administrative Code Rule 62-296, “Stationary Sources—Emission Standards,” establishes emission limiting standards and compliance requirements for stationary sources of air pollutant emissions.
FAC 62-520	Florida Administrative Code Rule 62-520, “Ground Water Classes, Standards, and Exemptions,” establishes water quality standards to protect designated beneficial uses of all ground waters of the State of Florida.
FAC 62-528	Florida Administrative Code Rule 62-528, “Underground Injection Control,” establishes provisions to protect the quality of the State’s underground sources of drinking water and to prevent degradation of the quality of other aquifers adjacent to the injection zone that may be used for other purposes.
Fla. Stat. § 258.397	Florida Statute Section 258.397, “Biscayne Bay Aquatic Preserve,” designates Biscayne Bay in Miami-Dade and Monroe Counties (including Card Sound) as an aquatic preserve under the provisions of Florida Statutes Title XVIII, “Public Lands and Property,” to be preserved in an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations.

Law/regulation	Requirements
Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.	The Wild and Scenic Rivers Act created the National Wild and Scenic Rivers System, which was established to protect the environmental values of free-flowing streams from degradation by impacting activities, including water resources projects.
	Waste management and pollution prevention
Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq.	The Resource Conservation and Recovery Act (RCRA) requires the EPA to define and identify hazardous waste; requires the EPA to establish standards for its transportation, treatment, storage, and disposal; and requires permits for persons engaged in hazardous waste activities. Section 3006, “Authorized State Hazardous Waste Programs” (42 U.S.C. 6926), allows States to establish and administer these permit programs with EPA approval. EPA regulations implementing the RCRA are found in 40 CFR Parts 260 through 282. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, or disposed. The method of treatment, storage, or disposal also impacts the extent and complexity of the requirements.
Pollution Prevention Act, 42 U.S.C. 13101 et seq.	The Pollution Prevention Act establishes a national policy for waste management and pollution control that focuses first on source reduction, then on environmental issues, safe recycling, treatment, and disposal.
	Protected species
Endangered Species Act, 16 U.S.C. 1531 et seq.	The Endangered Species Act (ESA) was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7, “Interagency Cooperation,” of the Act requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) on Federal actions that may affect listed species or designated critical habitats.
50 CFR Part 17	Regulations in 50 CFR Part 17, “Endangered and Threatened Wildlife and Plants,” implement the ESA.
50 CFR Part 402	Regulations in 50 CFR Part 402, “Interagency Cooperation - Endangered Species Act of 1973, as Amended,” interpret and implement Sections 7(a)-(d) of the ESA regarding endangered or threatened species of fish, wildlife, or plants (“listed species”) and habitats of such species that have been designated as critical (“critical habitat”).
Magnuson–Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801–1884	The Magnuson–Stevens Fishery Conservation and Management Act, as amended, governs marine fisheries management in U.S. Federal waters. This Act created eight regional fishery management councils and includes measures to rebuild overfished fisheries, protect essential fish habitat, and reduce bycatch. Under Section 305 of this Act, Federal agencies are required to consult with the National Marine Fisheries Service for any Federal actions that may adversely affect essential fish habitat.
FAC 68A-27	Florida Administrative Code Rule 68A-27, “Rules Relating to Endangered or Threatened Species,” establishes provisions to conserve or improve the status of endangered and threatened species in Florida.

Law/regulation	Requirements
	Historic preservation and cultural resources
National Historic Preservation Act, 16 U.S.C. 470 et seq.	The National Historic Preservation Act was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation (ACHP). Section 106 of this Act requires Federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing Section 106 of the Act are found in 36 CFR Part 800, “Protection of Historic Properties.”
36 CFR Part 60	Regulations in 36 CFR Part 60, “National Register of Historic Places,” establish procedural requirements for listing properties on the National Register of Historic Places.
36 CFR Part 800	Regulations in 36 CFR Part 800, “Protection of Historic Properties,” establish provisions for public involvement in the National Historic Preservation Act Section 106 consultation process, including involvement from Indian Tribes and other interested members of the public, as applicable.

B.2 Operating Permits and Other Requirements

Table B-2 lists the permits and licenses issued by Federal, State, and local authorities for activities at Turkey Point, as identified in Chapter 9 of Florida Power & Light Company’s environmental report submitted as part of its subsequent license renewal application.

Table B-2 Federal, State, and Local Permits and Other Requirements

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
		Federal Authorizations		
Authorization to export waste	Southeast Compact Commission	None	Updated annually	Export of LLRW outside the region
General license for storage of spent fuel at power reactor sites	NRC	General permit	N/A	Storage of power reactor spent fuel and other associated radioactive materials in an ISFSI
Licensing of nuclear power plant	NRC	DPR-31	7/19/2032	Operation of Unit 3
Licensing of nuclear power plant	NRC	DPR-41	4/10/2033	Operation of Unit 4
Consent decree	U.S. District Court	70-328-CA	N/A	IWW Construction, Operation, and Maintenance
Registration	U.S. Department of Transportation	060911 551 091T	None	Hazardous materials shipments
Section 401/404 permit; Submerged lands permit	U.S. Army Corps of Engineers (USACE) & Florida Department of Environmental Protection (FDEP)	SAJ-2016-02462 (USACE); 13-0127512-013 (FDEP)	5/7/2023 (USACE); 9/20/2021 (FDEP)	Discharge of dredge and fill materials into waters of the U.S. (Turtle Point and Barge Terminal) and use of state-owned submerged lands

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
NPDES permit - Industrial Waste Water facility (IWW) (cooling canals)	FDEP	FL0001562	May 2010 (administratively continued thereafter); draft permit issued 12/27/2018	Operation of IWW (cooling canals)
Hazardous waste generator number	USACE & FDEP	FLR000192922	N/A	Small Quantity Hazardous Waste Generator
Endangered species permit to take American crocodile during monitoring	U.S. Fish and Wildlife Service (USFWS)	TE092945-2	4/20/2018 (renewal in progress)	Provides authorization to take (capture, examine, weigh, sex, collect tissue samples, mark, radio-tag, radio-track, relocate, release) threatened American crocodile individuals during population monitoring
Effects of operation on the threatened American crocodile	USFWS	41420-2006-FA-0478; 41420-2006-F-0125	N/A	Plan to minimize the potential adverse effects of ongoing operations of PTN to the American crocodile
Migratory bird special purpose utility permit	USFWS	MB697722-0	3/31/2021	Authorizes utilities to collect, transport and temporarily possess migratory birds found dead on utility property, structures, and ROWs for avian mortality monitoring or disposal purposes
		State of Florida Authorizations		
Power plant site certification	FDEP Siting Board	PA 03-45E	Final conditions of certification issued 3/29/2016	Certification of Turkey Point site, initiated by PTN uprate. Provides for CZMA certification confirmation and CWA 401 certification
Power plant site certification	South Florida Water Management District (SFWMD)	N/A	N/A	Implementation of new monitoring plan that includes groundwater, surface water, and ecological monitoring in and around the Turkey Point CCS
Operation of Recovery Well System consumptive use permit	SFWMD	13-06251-W	2/27/2029	Use of Recovery Well System to extract hypersaline plume

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
Certification of state water quality standards	FDEP	PA 03-45E	Final conditions of certification issued 3/29/2016	Discharges during license renewal term
Operation of Class V, Group 3 domestic wastewater injection (gravity flow) well	FDEP	0355186-001-UO/5W	Issued 1/25/2023	Operation of IW-1
Operation of domestic wastewater treatment facility	FDEP	FLA013612-005-DW3P	9/27/2020	Operation of PTN wastewater treatment facility
Annual storage tank registration	FDEP	Facility ID: 8622249 Placard No.: 110600	Annual renewal	Operation of above-ground storage tanks
Annual storage tank registration	FDEP	Facility ID: 8622251 Placard No.: 110599	Annual renewal	Operation of above-ground storage tanks
Title V operations permit	FDEP	025003-028-AV	4/26/2023	Operation of facilities that generate air emissions
Underground injection control permit, injection well and monitoring well	FDEP	29392-004-UO/1I	7/12/2023	Disposal of extracted hypersaline water
Operation of freshening wells	FDEP	PA 03-45E	Final conditions of certification issued 3/29/2016	Withdrawal of groundwater for freshening of the IWW
Migratory bird nest removal	Florida Fish and Wildlife Conservation Commission (FFWCC)	LSNR-11-00026D	12/31/2020	Authorization to remove and replace inactive nests of migratory birds
Scientific collection permit	FFWCC	LSSC-11-00021B	12/31/2019	Scientific collection for avian species
Special purpose permit	FFWCC	SPGS-14-35	4/10/2019	Capture, hold and relocate American alligators
Burn permit	Florida Department of Agriculture and Consumer Service	1373498	No expiration	Authorization for open fires
Other States' Authorizations				
Revision of existing general site access permit	Utah Department of Environmental Quality Division of Radiation Control	None	Annual authorization	Transport of radioactive materials into the State of Utah

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
Revision of existing Tennessee radioactive waste license for delivery	Tennessee Department of Environment and Conservation Division of Radiological Health	None	Annual authorization	Transport of radioactive waste into the State of Tennessee
		Local Authorizations		
Stratospheric ozone protection annual operations permit	Miami-Dade County, Department of Environmental Resources Management (MDC DERM)	APCF-001747-2018/2019	June 30, 2019 Annual renewal	Use of refrigerants R-134A, R-22, R 410A, R-502 for Robinair Recovery Units, Models 25200, 25200B and 34700Z.
Industrial waste annual operations permit	MDC DERM	IW-000003-2018/2019	May 31, 2019 Annual renewal	Oil and water separators and hazardous waste storage and used oil containment areas
Domestic wastewater annual operating permit	MDC DERM	DWO-000010-2018/2019	April 14, 2019 Annual renewal	Stabilization treatment facility
IW5 permit (or waiver)	MDC DERM	IW-000016-2018/2019	May 31, 2019 Annual renewal	Water treatment units, oil drum and compressed gasses storage, and vehicle refueling station
Research permit on MDC DERM environmentally endangered lands	MDC DERM	2011	Under agency review	Authorization to conduct ecological monitoring on county-owned environmentally endangered lands
Operation of pollution control facility permit	MDC DERM	IW5-006229-2018/2019	April 30, 2019	Operation of fleet vehicle maintenance facility that generates waste oil, coolant, and used batteries with a solvent wash tank and served by septic tank

Source: FPL 2019

APPENDIX C
CONSULTATION CORRESPONDENCE

C.1 Endangered Species Act Section 7 Consultation

As a Federal agency, the U.S. Nuclear Regulatory Commission (NRC) must comply with the Endangered Species Act of 1973, as amended (16 United States Code (U.S.C.) Section 1531 et seq.; herein referred to as ESA), as part of any action authorized, funded, or carried out by the agency. In this case, the proposed agency action is whether to issue subsequent renewed licenses for the continued operation of Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4), which would authorize operation for an additional 20 years beyond the end of the current renewed license terms. Under Section 7, "Interagency Cooperation," of the ESA, the NRC must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) (referred to jointly as "the Services" and individually as "Service"), as appropriate, to ensure that the proposed agency action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

C.1.1 Federal Agency Obligations under Section 7 of the Endangered Species Act

The ESA and the regulations that implement Section 7 of the ESA (Title 50, "Wildlife and Fisheries," of the *Code of Federal Regulations* (50 CFR) Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended") describe the consultation process that Federal agencies must follow in support of agency actions. As part of this process, the Federal agency shall either request that the Services (1) provide a list of any listed or proposed species or designated or proposed critical habitats that may be present in the action area or (2) request that the Services concur with a list of species and critical habitats that the Federal agency has created (50 CFR 402.12(c), "Request for Information"). If any such species or critical habitats may be present, the Federal agency prepares a biological assessment to evaluate the potential effects of the action on the species or critical habitat and to determine whether the species or critical habitat are likely to be adversely affected by the action (50 CFR 402.12(a), "Purpose"; 16 U.S.C. 1536(c)). Biological assessments are required for any agency action that is a "major construction activity" (50 CFR 402.12(b), "Preparation Requirement"), which is defined as a construction project or other undertaking having construction-type impacts that is a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.; herein referred to as NEPA) (51 FR 19926). Federal agencies may fulfill their obligations to consult with the Services under ESA Section 7 and to prepare a biological assessment, if required, in conjunction with the interagency cooperation procedures required by other statutes, including NEPA (50 CFR 402.06(a)). In such cases, the Federal agency should include the results of the ESA Section 7 consultation in the NEPA document (50 CFR 402.06(b)).

C.1.2 Biological Assessment

Subsequent license renewal does not require the preparation of a biological assessment because it is not a major construction activity. However, the NRC staff prepared a biological assessment (NRC 2018n) to evaluate the potential impacts of Turkey Point subsequent license renewal on the American crocodile (*Crocodylus acutus*), 14 other species under the FWS's jurisdiction, and designated critical habitat for the American crocodile and the West Indian manatee (*Trichechus manatus*). The staff included a summary of the results of the biological assessment in Section 4.8.1.1, "Species and Habitats Protected Under the Endangered Species Act," of this supplemental environmental impact statement (SEIS). Additionally, this SEIS includes an evaluation of the potential impacts to federally listed species and critical habitats under the NMFS's jurisdiction to support the NRC's ESA effect determinations for listed species and critical habitats that may occur in the action area. The staff did not prepare a separate biological assessment for species under the NMFS's jurisdiction due to the limited number of listed species and the minimal potential effects on these species. Therefore, Section 4.8.1.1 of this SEIS contains the NRC staff's assessment of impacts to NMFS-listed species.

The NRC staff structured its evaluation of impacts to both FWS- and NMFS-listed species in accordance with the Services' suggested biological assessment contents described at 50 CFR 402.12(f), "Contents." Within Section 3.8, "Special Status Species and Habitats," of this SEIS and Sections 4.0 through 6.0 of the biological assessment, the NRC staff describes the action area as well as the federally listed and proposed species and designated and proposed critical habitats potentially present in the action area. These sections include information pursuant to 50 CFR 402.12(f)(1), (2), and (3). Section 4.8, "Special Status Species and Habitats," of this SEIS and Sections 4.0 through 7.0 of the biological assessment provide an assessment of the potential effects of the proposed Turkey Point subsequent license renewal on the species and critical habitats present. These sections also contain the NRC's ESA effect determinations, which are consistent with the conclusions described in Section 3.5 of the *Endangered Species Consultation Handbook* (FWS and NMFS 1998). Finally, Section 4.8 of this SEIS and Section 8.0 of the biological assessment address cumulative effects and alternatives to the proposed action pursuant to 50 CFR 402.12(f)(4) and (5).

C.1.3 Chronology of Endangered Species Act Section 7 Consultation

<u>Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service</u>

During its review of the Turkey Point subsequent license renewal application, the NRC staff considered whether any federally listed, proposed, or candidate species or proposed or designated critical habitats may be present in the action area (as defined at 50 CFR 402.02, "Definitions") for the proposed action. With respect to species under the FWS's jurisdiction, the FWS identified 46 federally listed species, as well as designated critical habitat for two of those species, that have the potential to occur in the vicinity of the action area in a letter to the NRC dated December 14, 2018 (FWS 2018b). In Section 3.8 of this SEIS and Enclosure 1 of the biological assessment (NRC 2018n), the NRC staff concludes that 25 species would not occur in the action area because those species are extirpated from Miami-Dade County, are not known to occur within Miami-Dade County, or no suitable habitat occurs within the action area. In addition, two species are listed because of similarity of appearance to other listed species, and therefore, are not subject to ESA Section 7 consultation. The FWS and the NMFS have joint jurisdiction for four of the species; the proposed action would have no effect on the portions of the life cycle that are under the FWS's jurisdiction for these species (NRC 2018g). The NRC staff evaluates the impacts to the remaining 15 species and designated critical habitat for two of those species in Sections 4.0 and 5.0 of the biological assessment. Section 4.8 of this SEIS contains a summary of the staff's findings. In the biological assessment, the staff concludes that the proposed subsequent license renewal may affect, but is not likely to adversely affect, 13 species and that the proposed subsequent license renewal is likely to adversely affect the American crocodile and the eastern indigo snake (*Drymarchon corais couperi*). The staff also concludes that the proposed subsequent license renewal is not likely to adversely modify designated critical habitat for the West Indian manatee but may adversely modify designated critical habitat for the American crocodile. No other FWS listed, proposed, or candidate species or proposed or designated critical habitats occur in the action area. By letter dated December 19, 2018 (NRC 2018o), the NRC staff submitted a copy of the biological assessment to the FWS for review accompanied by a request for the FWS to concur with the staff's (1) "may affect, but is not likely to adversely affect" determinations for 13 species, (2) "not likely to adversely modify designated critical habitat" determination for the West Indian manatee, (3) "may adversely modify designated critical habitat" determination for the American crocodile, and (4) request to enter formal consultation for the American crocodile and the eastern indigo snake in accordance with 50 CFR 402.12(j) and 50 CFR 402.14, "Formal Consultation." The NRC staff will update this section in the final SEIS to include any correspondence transpiring between the issuance of this draft SEIS and the final SEIS.

Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

During its review of the Turkey Point subsequent license renewal application, the NRC staff considered whether any federally listed, proposed, or candidate species or proposed or designated critical habitats may be present in the action area (as defined at 50 CFR 402.02, "Definitions") for the proposed action. With respect to species under the NMFS's jurisdiction, the NMFS identified five federally listed species that have the potential to occur in the vicinity of the Turkey Point site in a letter to the NRC dated April 26, 2017 (NMFS 2017). The five species are loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and smalltooth sawfish (*Pristis pectinata*). The NRC staff evaluated the potential impacts to these species in Section 3.8 and Section 4.8 of this SEIS. The staff concludes that the proposed subsequent license renewal may affect but is not likely to adversely affect these species. No other NMFS listed, proposed, or candidate species or proposed or designated critical habitats occur in the action area. The NRC staff will submit a copy of this draft SEIS, upon its issuance, to the NMFS for review accompanied by a request for the NMFS to concur with the staff's "may affect, but is not likely to adversely affect" determinations in accordance with 50 CFR 402.12(j). The NRC staff will update this section in the final SEIS to include any correspondence transpiring between the issuance of this draft SEIS and the final SEIS.

C.2 Essential Fish Habitat Consultation

The Magnuson–Stevens Fishery Conservation and Management Act, as amended (16 U.S.C. 1801–1884), requires Federal agencies to consult with the NMFS with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect any Essential Fish Habitat identified under the Act.

In Sections 3.8 and 4.8 of this SEIS, the NRC staff concludes that although the NMFS has designated Essential Fish Habitat for a number of federally managed species within Biscayne Bay, neither Essential Fish Habitat nor the species themselves occur in the CCS or on the Turkey Point site because there are no surface water connections between the CCS and any natural waterbodies and that the proposed Turkey Point subsequent license renewal would not result in any impacts to Essential Fish Habitat. Accordingly, the NRC is not required under the Act to consult with the NMFS for the proposed action.

C.3 National Historic Preservation Act Section 106 Consultation

The National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.; herein referred to as NHPA), requires Federal agencies to take into account the effects of their undertakings on historic properties and consult with applicable State and Federal agencies, Tribal groups, individuals, and organizations with a demonstrated interest in the undertaking before taking action. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800, "Protection of Historic Properties." In accordance with 36 CFR 800.8(c), "Use of the NEPA Process for Section 106 Purposes," the NRC has elected to use the NEPA process to comply with its obligations under Section 106 of the NHPA.

Table C-1 lists the chronology of consultation and consultation documents related to the NRC's NHPA Section 106 review of the Turkey Point subsequent license renewal. The NRC staff is required to consult with the noted agencies and organizations in accordance with the statute and regulations listed in the previous paragraph.

Table C-1 National Historic Preservation Act Correspondence

Date	Sender and Recipient	Description	ADAMS Accession No. [a]
May 24, 2018	B. Beasley (NRC) to B. Cypress, Miccosukee Tribe of Indians of Florida	Request for scoping comments/notification of Section 106 review	ML18114A381
May 24, 2018	B. Beasley (NRC) to J. Floyd, Muscogee (Creek) Nation	Request for scoping comments/notification of Section 106 review	ML18114A381
May 24, 2018	B. Beasley (NRC) to S.A. Bryan, Poarch Band of Creek Indians	Request for scoping comments/notification of Section 106 review	ML18114A381
May 24, 2018	B. Beasley (NRC) to G. Chilcoat, Seminole Nation of Oklahoma	Request for scoping comments/notification of Section 106 review	ML18114A381
May 24, 2018	B. Beasley (NRC) to M.W. Osceola, Seminole Tribe of Florida	Request for scoping comments/notification of Section 106 review	ML18114A381
May 24, 2018	B. Beasley (NRC) to T. Parsons, Florida Department of State, Division of Historical Resources	Request for scoping comments/notification of Section 106 review	ML18114A206
May 24, 2018	B. Beasley (NRC) to S. Cody, Miami-Dade County Office of Historic Preservation	Request for scoping comments/notification of Section 106 review	ML18114A204
May 24, 2018	B. Beasley (NRC) to R. Nelson, Advisory Council on Historic Preservation	Request for scoping comments/notification of Section 106 review	ML18114A202
June 12, 2018	T. Isham, Seminole Nation of Oklahoma to N. Martinez (NRC)	Request for Section 106 consultation meetings	ML18169A152
June 26, 2018	T.A. Parsons, Florida Department of State to M. Ma (NRC)	Response to request for scoping comments/notification of Section 106 review	ML18183A482
July 3, 2018	V. Menchaca, Seminole Tribe of Florida to J. Borges Roman (NRC)	Response to request for scoping	ML18184A462

Date	Sender and Recipient	Description	ADAMS Accession No. [a]
		comments/notification of Section 106 review	
July 19, 2018	N. Martinez (NRC) to B. Beasley (NRC)	Summary of teleconference between the NRC and the Seminole Nation of Oklahoma	ML18190A179

[a] Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://adams.nrc.gov/wba/.

APPENDIX D
CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of the agency's environmental review of the Turkey Point Nuclear Generating Unit Nos. 3 & 4 (Turkey Point, or Turkey Point Units 3 and 4) subsequent license renewal application. This appendix does not include consultation correspondence or comments received during the scoping process. For a list and discussion of consultation correspondence, see Appendix C, "Consultation Correspondence," of this supplemental environmental impact statement (SEIS). For scoping comments, see Appendix A, "Comments Received on the Turkey Point Nuclear Generating Units 3 and 4 Environmental Review," of this SEIS and the NRC's scoping summary report (NRC 2019). All documents are available electronically from the NRC's Public Electronic Reading Room found at: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to ADAMS, which provides text and image files of the NRC's public documents. The ADAMS accession number for each document is included in the following table.

D.1 Environmental Review Correspondence

Table D-1 lists the environmental review correspondence, by date, beginning with the request by Florida Power & Light Company (FPL) for subsequent license renewal of the operating licenses for Turkey Point Units 3 and 4.

Table D-1 Environmental Review Correspondence

Date	Correspondence Description	ADAMS Accession No.
January 30, 2018	Turkey Point Units 3 and 4—Submittal of Subsequent License Renewal Application	ML18037A812
February 9, 2018	Turkey Point Units 3 and 4 License Renewal Application—Supplement 1	ML18044A653
February 16, 2018	Turkey Point, Units 3 and 4, Subsequent License Renewal Application—Supplement 2	ML18053A123
March 1, 2018	Turkey Point Units 3 and 4, Subsequent License Renewal Application—Supplement 3	ML18072A224
March 22, 2018	Press Release 18-009: NRC Makes Available First Subsequent License Renewal Application from Turkey Point Nuclear Power Plant	ML18085A035
April 10, 2018	Turkey Point, Units 3 and 4, Subsequent License Renewal Application Appendix E Environmental Report Supplemental Information	ML18102A521
April 10, 2018	Turkey Point Units 3 and 4—Transmittal of Subsequent License Renewal Application, Revision 1	ML18113A132
April 12, 2018	Turkey Point Nuclear Generating Units 3 and 4—Status of Subsequent License Renewal Application (EPID No. L-2018-RNW-0002)	ML18074A252
April 13, 2018	Receipt and Availability of the Subsequent License Renewal Application for the Turkey Point Nuclear Generating Units 3 and 4	ML17338A141

Date	Correspondence Description	ADAMS Accession No.
April 25, 2018	Turkey Point Nuclear Generating Units 3 and 4, Subsequent License Renewal Application Online Reference Portal (EPID No. L-2018-RNW-002)	ML17360A054
April 26, 2018	Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from FPL for Subsequent Renewal of the Turkey Point Units 3 and 4 (CAC Nos. MF9747 and MF9747)	ML18003A050
May 3, 2018	Press Release 18-014: NRC Accepts Application for Subsequent License Renewal of Turkey Point Reactors	ML18124A078
May 14, 2018	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for Turkey Point Nuclear Plant Units 3 and 4	ML18109A516
May 22, 2018	Press Release 18-019: Corrected—NRC To Hold Meeting on Environmental Review for Turkey Point Subsequent License Renewal	ML18145A064
May 25, 2018	05/31/2018 Public Scoping Meeting for the Environmental Review of the Subsequent License Renewal Application for Turkey Point Units 3 and 4	ML18145A201
June 13, 2018	License Renewal Environmental Site Audit Regarding the Turkey Point Nuclear Generating Units 3 and 4 Subsequent License Renewal Application (EPID No. L-2018-LNE-0001).	ML18158A335
June 22, 2018	Letter from the National Park Service (S. Craighead), to the NRC pertaining to the Turkey Point, Units 3 and 4 Subsequent License Renewal	ML18193B074
July 3, 2018	Turkey Point Nuclear Generating Units 3 and 4—In-Office Regulatory Audit Plan Regarding Severe Accident Mitigation Alternatives in the Subsequent License Renewal Application Review (EPID No. L-2018-LNE-0001)	ML18178A152
July 9, 2018	Requests for Additional Information for the Environmental review of the Turkey Point Subsequent License Renewal Application (EPID No. L-2018-LNE-0001)	ML18190A499
July 17, 2018	Requests for Additional Information for the Environmental Review of the Turkey Point Subsequent License Renewal Application—Set 2 (EPID No. L-2018-LNE-0001)	ML18198A274
July 20, 2018	Summary of the Site Environmental Audit Related to the Review of the Subsequent License Renewal Application for Turkey Point Nuclear Generating Units 3 and 4 (EPID No. L-2018-LNE-0001)	ML18178A229
July 20, 2018	National Park Service Cooperating Agency Request for Subsequent License Renewal of Turkey Point Nuclear Generating Units 3 and 4 (EPID No. L-2018-LNE-0001)	ML18197A294
July 23, 2018	05/31/2018 Summary of Public Scoping Meeting for the Environmental Review of the Subsequent License Renewal Application for Turkey Point Units 3 and 4 (EPID No. L-2018-LNE-0001)	ML18176A403
August 8, 2018	Turkey Point Units 3 and 4 Subsequent License Renewal Application Environmental Report Requests for Additional Information (RAI) Responses	ML18247A507

Date	Correspondence Description	ADAMS Accession No.
August 17, 2018	Notice of Public Meeting—Turkey Point Subsequent License Renewal Application Review—Discussion of Responses to Two Environmental Requests for Additional Information—HC-7 and WR-2	ML18229A111
August 31, 2018	Turkey Point Nuclear Generating Units 3 and 4—Summary of the In-Office Regulatory Audit Regarding Severe Accident Mitigation Alternatives in the Subsequent License Renewal Application (EPID No. L-2018-LNE-0001)	ML18214A146
September 17, 2018	Requests for Additional Information for the Turkey Point Subsequent License Renewal Application—Environmental Set 3 (EPID No. L-2018-LNE-0001)	ML18248A158
September 18, 2018	08/28/2018 Summary of Meeting to Discuss Turkey Point Subsequent License Renewal Application Review - Discussion of Responses to Two Environmental Requests for Additional Information - HC-7 and WR-2 (EPID No. L-2018-LNE-0001)	ML18247A301
September 27, 2018	Teleconference Summary with NRC and FWS Re: Species under Joint NMFS and FWS Jurisdiction for Turkey Point Subsequent License Renewal	ML18270A154
October 5, 2018	Turkey Point, Units 3 and 4, Responses to Requests for Additional Information for Subsequent License Renewal Application Environmental Review	ML18283A882
November 11, 2018	11/13/2018 Telecon Between NRC and FPL to Discuss Items Associated with the Safety Review of the Turkey Point Subsequent License Renewal Application	ML18315A003
November 28, 2018	Turkey Point, Units 3 and 4, Supplemental Response to Request for Additional Information (RAI) Set 1, Subsequent License Renewal Application Environmental Review	ML18334A101
December 19, 2018	Letter to FWS transmitting Biological Assessment for the Turkey Point Units 3 and 4 Proposed Subsequent License Renewal	ML18344A008
December 26, 2018	06/18/18 Summary of Interagency Meeting Related to Subsequent License Renewal for Turkey Point Nuclear Generating Unit Nos. 3 and 4	ML18360A445
January 2019	Environmental Scoping Summary Report Associated with the Staff's Review of the Turkey Point Nuclear Generating Units 3 and 4 Subsequent License Renewal Application (EPID No. L-2018-LNE-0001)	ML18342A014
March 5, 2019	Letter from National Parks Service to NRC providing comments on preliminary drafts of parts of Chapter 3 and Chapter 4 of Turkey Point Subsequent License Renewal Draft SEIS	ML19072A162

APPENDIX E
ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This section describes the environmental impacts from postulated accidents that may occur at Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point, or Turkey Point Units 3 and 4) during the subsequent license period. The term "accident" refers to any unintentional event outside the normal plant operational envelope that could result in either (a) an unplanned release of radioactive materials into the environment or (b) the potential for an unplanned release of radioactive materials into the environment. NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NRC 1996, 2013a), evaluates in detail the following two classes of postulated accidents as they relate to license renewal:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core, whether or not there are serious off-site consequences.

This section first describes the evaluation of new and significant information as it relates to design-basis accidents, followed by an evaluation of new and significant information for severe accidents.

E.1 Background

Although this supplemental environmental impact statement documents the NRC staff's review of a subsequent license renewal application, it is helpful to keep in mind that long before any license renewal actions, an operating reactor has already completed the NRC licensing process for the original 40-year operating license. To receive a license to operate a new nuclear power reactor, an applicant must submit to the NRC an operating license application that includes, among many other requirements, a safety analysis report. The applicant's safety analysis report presents the design criteria and design information for the proposed reactor and includes comprehensive data on the proposed site. The applicant's safety analysis report also describes various design-basis accidents and the safety features designed to prevent or mitigate their impacts. The NRC staff reviews the operating license application to determine if the plant's design—including designs for preventing or mitigating accidents—meet the NRC's regulations and requirements.

E.1.1 Design-Basis Accidents

Design-basis accidents are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. Planning for design-basis accidents ensures that the proposed plant can withstand normal transients (rapid changes in the reactor coolant system temperature or pressure, or rapid changes in reactor power), as well as a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. Many of these design-basis accidents may occur, but are unlikely to occur even once during the life of the plant; nevertheless, carefully evaluating each design-basis accident is crucial to establishing the design basis for the preventive and mitigative safety systems of the proposed nuclear power plant. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 100, "Reactor Site Criteria," describe the NRC's acceptance criteria for design-basis accidents.

Before the NRC will issue an operating license for a new nuclear power plant, the applicant must demonstrate the ability of its proposed reactor to withstand all design-basis accidents. The applicant and the NRC staff evaluate the environmental impacts of design-basis accidents for the hypothetical maximum-exposed individual. The results of these evaluations of design-basis accidents are found in the reactor's original licensing documents such as the applicant's final safety analysis report, the NRC staff's safety evaluation report, and the final environmental statement (FES). Once the NRC issues the operating license for the new reactor, the licensee is required to maintain the acceptable design and performance criteria (which includes withstanding design-basis accidents) throughout the operating life of the nuclear power plant, including any license renewal periods of extended operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations.

Pursuant to 10 CFR 54.29(a), license renewal applicants are required to manage the effects of aging and perform any required time-limited aging analyses (as further described in the regulation), such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the plant's current licensing basis (CLB) and any changes made to the plant's CLB in order to comply with section 54.29 are in accordance with the Atomic Energy Act and the Commission's regulations. In other words, because of the requirements that the existing design-basis and aging management programs be in effect for license renewal, the environmental impacts of design-basis accidents as calculated for the original operating license application should not differ significantly from the environmental impacts of design-basis accidents at any other time during plant operations, including during the initial license renewal and subsequent renewal periods. Accordingly, the design of the nuclear power plant, relative to design-basis accidents during the period of extended operation, is considered to remain acceptable.

E.1.2 Design-Basis Accidents and License Renewal

The early identification and resolution of the design-basis accidents (prior to subsequent license renewal) makes them a part of the current licensing basis (CLB) of the plant. The NRC requires licensees to maintain the CLB of the plant under the current operating license, as well as during any license renewal period. Therefore, under the provisions of 10 CFR 54.30, "Matters not Subject to a Renewal Review," design-basis accidents are not subject to review under license renewal.

As stated in Section 5.3.2 of the 1996 GEIS, the environmental impact from design-basis accidents was assessed in the individual plant-specific EISs at the time of the initial license application review. Since the licensee is required to maintain the plant within acceptable design and performance criteria, including during any license renewal term, these environmental impacts are not expected to change significantly. Therefore, additional assessment of the environmental impacts from design-basis accidents is not necessary (NRC 2013a).

The GEIS concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants, because the plants were designed to successfully withstand these accidents. For the purposes of initial or subsequent license renewal, the NRC designates design-basis accidents as a Category 1 generic issue—applicable to all nuclear power plants (see 10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants"). During the license renewal review process, the NRC staff adopts the applicable Category 1 issue conclusions from the GEIS (unless there exists new and significant information about the issue). Hence, the NRC staff need not address most Category 1 issues (like design-basis accidents) in the site-specific supplemental environmental impact statement for license renewal, in the absence of new and significant information pertinent to those issues.

In its environmental report for the Turkey Point subsequent license renewal application, Florida Power & Light Company (FPL) did not identify any new and significant information related to design-basis accidents at Turkey Point (FPL 2018f). The NRC staff also did not identify any new and significant information related to design-basis accidents during its independent review of FPL's environmental report, through the scoping process, or in its evaluation of other available information. Therefore, the NRC staff concludes that there are no environmental impacts related to design-basis accidents at Turkey Point during the subsequent license renewal period beyond those already discussed generically for all nuclear power plants in the GEIS.

E.1.3 Severe Accidents

Severe accidents are postulated accidents that are more severe than design-basis accidents because severe accidents can result in substantial damage to the reactor core, whether or not there are serious offsite consequences. Severe accidents can entail multiple failures of equipment or function. The likelihood of a severe accident occurring is generally even lower than the likelihood of a design-basis accident occurring.

E.1.4 Severe Accidents and License Renewal

Chapter 5 of the 1996 GEIS (NUREG-1437) conservatively predicts the environmental impacts of postulated severe accidents that may occur during the period of extended operations at nuclear power plants. In the 2013 GEIS, the staff updated the NRC's 1996 plant-by-plant severe accident environmental impact assessments (NRC 2013a, Appendix E). In the GEIS, the impacts of severe accidents that were considered include:

- dose and health effects of accidents
- economic impacts of accidents
- effect of uncertainties on the results

The NRC staff calculated these estimated impacts by studying the risk analysis of severe accidents as reported in the environmental impact statements (EISs) and/or final environmental statements that the NRC staff had prepared for each of the plants in support of their original reactor operating licenses. When the NRC staff prepared the 1996 GEIS, 28 nuclear power plant sites (44 units) had EISs or FESs that contained a severe accident analysis. Not all original operating reactor licenses contain a severe accident analysis since the NRC has not always required such analyses. The 1996 GEIS assessed the impacts of severe accidents during the license renewal period, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for all plants during the renewal period. With few exceptions, the severe accident analyses evaluated in the 1996 GEIS were limited to consideration of reactor accidents caused by internal events. The 1996 GEIS addressed the impacts from external events qualitatively.

For its severe accident environmental impact analysis for each plant, the 1996 GEIS used very conservative 95th percentile upper confidence bound estimates for environmental impact whenever available. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 GEIS. The 1996 GEIS concluded that the probability-weighted impacts of severe accidents as related to license renewal are small compared to other risks to which the populations surrounding nuclear power plants are routinely exposed. The NRC's understanding of severe accident risk has continued to evolve since it issued the 1996 GEIS. The updated 2013 GEIS assesses more recent information and developments in severe accident analyses and how they might affect the conclusions in Chapter 5 of the 1996 GEIS. The 2013 GEIS also provides comparative data where appropriate. Based on information in the 2013 GEIS, the NRC staff determined that for all nuclear power plants, the probability-weighted consequences of severe accidents are SMALL. However, the GEIS determined that alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives, as a Category 2 issue. See Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," of Appendix B to Subpart A of 10 CFR Part 51, which states:

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

An analysis of severe accident mitigation alternatives was performed for Turkey Point at the time of initial license renewal. The staff documented its review in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," Supplement 5, Regarding Turkey Point Nuclear Plant, Units 3 & 4. Any new and significant information that might alter the conclusions of that analysis was considered for subsequent license renewal, as discussed below.

E.2 Severe Accident Mitigation Alternatives

In a SAMA analysis, the NRC requires license renewal applicants to consider the environmental impacts of severe accidents, their probability of occurrence, and potential means available to mitigate those accidents. As quoted above, 10 CFR Part 51, Table B-1 states "alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives." This NRC requirement to consider alternatives to mitigate severe accidents can be fulfilled by a severe accident mitigation alternatives (SAMA) analysis. The purpose of the SAMA analysis is to identify design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents at nuclear power plants and that are also potentially cost beneficial to implement. The SAMA analysis includes the identification and evaluation of SAMAs that may reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 2013b). The regulations at 10 CFR 51.53(c)(3)(ii)(L) state that each license renewal applicant must submit an environmental report that considers alternatives to mitigate severe accidents, "If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment."

E.2.1 Turkey Point Initial License Renewal Application and SAMA Analysis in 2000

As part of its initial license renewal application submitted in 2000, FPL's environmental report included an analysis of SAMAs for Turkey Point Units 3 and 4 (FPL 2000). FPL based this SAMA analysis on (1) the Turkey Point probabilistic safety assessment (PSA) for total accident frequency, core damage frequency (CDF), and containment large early release frequency (LERF), and (2) a supplemental analysis of offsite consequences and economic impacts for risk determination. The Turkey Point PSA included a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to determine containment performance during severe accidents. The offsite consequences and economic impacts analyses used the MELCOR Accident Consequence Code System 2 (MACCS2) code, Version 1.2, to determine the offsite risk impacts on the surrounding environment and the public. Inputs for the latter analysis included plant/site-specific values for core radionuclide inventory, source term and release fractions, meteorological data, projected population distribution (based on 1990 census data, projected out to 2025), emergency response evacuation modeling, and economic data. To help identify and evaluate potential SAMAs, FPL considered insights and recommendations from SAMA analyses for other plants, potential plant improvements discussed in NRC and industry documents, and documented insights provided by Turkey Point staff.

In its 2000 environmental report, FPL considered 167 SAMAs. FPL then performed a qualitative screening of those SAMAs, eliminating SAMAs that were not applicable to Turkey Point or had already been implemented at Turkey Point (or the design met the intent of the SAMA). Based on this qualitative screening, 91 SAMAs were eliminated, leaving 76 subject to the final screening and evaluation process. Of the 91 SAMAs eliminated, 64 were eliminated because they had already been implemented at Turkey Point (or the design met the intent of the SAMA), while 27 SAMAs were eliminated because they were not applicable to Turkey Point. The 76 remaining SAMAs were listed in Table F.2-2 of Appendix F of the 2000 ER (FPL 2000). The final screening process involved identifying and eliminating those SAMAs whose cost exceeded twice their benefit. Ultimately, FPL concluded that there were no potentially cost-beneficial SAMAs associated with the initial Turkey Point license renewal (FPL 2000).

As part of the NRC staff's review of the initial Turkey Point license renewal application, the staff reviewed FPL's analysis of SAMAs for Turkey Point Units 3 and 4 and documented this review in its SEIS, which the NRC published in January 2002 as Supplement 5, "Regarding Turkey Point Nuclear Plant, Units 3 & 4," to NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC 2002c). Chapter 5 of Supplement 5 to NUREG-1437 contains the NRC staff's evaluation of the potential environmental impacts of plant accidents and examines each SAMA (individually and, in some cases, in combination) to determine the SAMA's individual risk reduction potential. The NRC staff then compared this potential risk reduction against the cost of implementing the SAMA to quantify the SAMA's cost-benefit value.

In Section 5.2 of its 2002 SEIS for the initial Turkey Point license renewal (NUREG-1437, Supplement 5), the NRC staff found that FPL used a systematic and comprehensive process for identifying potential plant improvements for Turkey Point Units 3 and 4, and that its bases for calculating the risk reductions afforded by these plant improvements were reasonable and generally conservative. Further, the NRC staff found that FPL's estimates of the costs of implementing each SAMA were reasonable and consistent with estimates developed for other operating reactors. In addition, the NRC staff concluded that FPL's cost-benefit comparisons were performed appropriately. The NRC staff concluded that FPL's SAMA methods and implementation of those methods were sound, and it agreed with FPL's conclusion that none of the candidate SAMAs were potentially cost beneficial based on conservative treatment of costs and benefits. The staff found FPL's conclusion consistent with the low residual level of risk indicated in the Turkey Point probabilistic safety assessment, and was also consistent with the fact that Turkey Point had already implemented many plant improvements identified during two risk analysis processes: (1) the individual plant examination or IPE (a risk analysis that considers the unique aspects of a particular nuclear power plant, identifying the specific vulnerabilities to severe accident of that plant) and (2) the individual plant examination for external events or IPEEE (a risk analysis that considers external events such as earthquakes, internal fires, and high winds) (NRC 2002c).

E.2.2 Turkey Point 2018 Subsequent License Renewal Application and New and Significant Information as it Relates to the Probability-Weighted Consequences of Severe Accidents

As mentioned above, a license renewal application must include an environmental report that describes SAMAs if the NRC staff has not previously evaluated SAMAs for that plant in an environmental impact statement (EIS), in a related supplement to an EIS, or in an environmental assessment. As also discussed above, the NRC staff performed a site-specific analysis of Turkey Point SAMAs in a supplement to an EIS (Supplement 5, "Regarding Turkey Point Nuclear Plant, Units 3 & 4," to NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants") (NRC 2002c). Therefore, in accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, FPL is not required to provide another SAMA analysis in its environmental report for the Turkey Point subsequent license renewal application.

The NRC's regulations in 10 CFR Part 51, which implement Section 102(2) of the National Environmental Policy Act (NEPA), require that all applicants for license renewal submit an environmental report to the NRC, in which they identify any ''new and significant information regarding the environmental impacts of license renewal of which the applicant is aware'' (10 CFR 51.53(c)(3)(iv)). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA analysis. Accordingly, in its subsequent license renewal application environmental report, FPL evaluates areas of new and significant information that could affect the environmental impact of postulated severe accidents during the subsequent license renewal period of extended operation, and possible new and significant information as it relates to SAMAs.

In FPL's assessment of new and significant information related to SAMAs in its SLR application, FPL utilized guidance that was recently issued by the Nuclear Energy Institute (NEI), which the NRC staff has endorsed. As discussed in Section E-5 below, NEI developed a model approach for license renewal applicants to use in assessing the significance of new information of which the applicant is aware, that relates to a prior SAMA analysis that was performed in support of the issuance of an initial license, renewed license, or combined license (COL). This effort led to the publication of NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA, Rev. 0," on June 29, 2017 (NEI 2017). NEI 17-04 provides a tiered approach that entails a 3-stage screening process for the evaluation of new information. In this screening process, new information is deemed to be "potentially significant" to the extent that it results in the identification in Stage 1 (involving the use of PRA risk insights and/or risk model quantifications) of an unimplemented SAMA that reduces the maximum benefit by 50 percent or more. If a SAMA is found to result in a 50 percent reduction in maximum benefit in Stage 1, a Stage 2 assessment would then be performed (involving an updated averted cost-risk estimate for implementing that SAMA). A Stage 3 assessment (involving a cost-benefit analysis) would be required only for “potentially significant” SAMAs, i.e., those that are shown by the Stage 2 assessment to reduce the maximum benefit by 50 percent or more. Finally, if the Stage 3 assessment shows that a “potentially significant” SAMA is “potentially cost-beneficial,” thus indicating the existence of “new and significant” information, then the applicant must supplement the previous SAMA analysis. The NRC endorsed NEI 17-04 for use by license renewal applicants on January 31, 2018 (NRC 2018m). FPL’s assessment of new and significant information related to its SAMA cost-benefit analysis is discussed in Section E.5 of this Appendix.

Below, the NRC staff summarizes FPL’s description of possible areas of new and significant information and assesses FPL’s conclusions.

E.3 Evaluation of New Information Concerning Severe Accident Consequences for Turkey Point as it relates to the GEIS and the 2002 Turkey Point SEIS.

The 2013 GEIS considers developments in plant operation and accident analysis that could have changed the assumptions made in the 1996 GEIS concerning severe accident consequences. The 2013 GEIS confirmed the determination in the 1996 GEIS that the probability-weighted consequences of severe accidents are small for all plants. In the 2013 GEIS, Appendix E provides the NRC staff’s evaluation of the environmental impacts of postulated accidents. Table E-19, “Summary of Conclusions,” shows the developments that the NRC staff considered as well as the staff’s conclusions. Consideration of the listed items was the basis for the NRC staff's overall determination in the 2013 GEIS that the probability-weighted consequences of severe accidents remain small for all plants.

For subsequent license renewal for Turkey Point, the staff confirmed that there is no new and significant information that would change the 2013 GEIS or the 2002 Turkey Point SEIS conclusions on the consequences of severe accidents. The NRC staff evaluated FPL’s information related to the 2013 GEIS, Table E-19, “Summary of Conclusions,” during the onsite Turkey Point audit and by reviewing docketed information (NRC 2018c). The results of that review follow.

E.3.1 New Internal Events Information (Section E.3.1 of the 2013 GEIS)

After FPL submitted the Turkey Point initial license renewal application environmental report in 2000 and the NRC issued its corresponding SAMA review in its 2002 SEIS, there have been many improvements to Turkey Point’s risk profile. The Turkey Point internal events core damage frequency in the initial license renewal SAMA was approximately 1.6×10^{-5}/year. The current Turkey Point internal events probabilistic risk assessment (PRA) model of record has a core damage frequency of approximately 7.0×10^{-7}/year. This change represents a 96-percent reduction or a factor-of-23 reduction in core damage frequency for each unit. This substantial improvement in CDF makes any proposed new SAMA or previously evaluated SAMA less likely to be cost beneficial.

In the 2013 GEIS, the NRC staff reviewed the updated boiling-water reactor (BWR) and pressurized-water reactor (PWR) internal event core damage frequencies (CDFs). The CDF is an expression of the likelihood that, given the way a reactor is designed and operated, an accident could cause the fuel in the reactor to be damaged. The 2013 GEIS addresses new information on the risk and environmental impacts of severe accidents caused by internal events which had emerged following issuance of the 1996 GEIS and included consideration of Turkey Point's plant-specific PRA analysis. The new information addressed in the 2013 GEIS indicates that PWR and BWR CDFs evaluated for the 2013 GEIS are generally comparable to or less than the CDFs that formed the basis of the 1996 GEIS (NRC 2013a).

Therefore, the NRC staff concludes that the offsite consequences of severe accidents initiated by internal events during the subsequent license renewal term would not exceed the impacts predicted in the 2013 GEIS. For these issues, the GEIS predicted that the impacts would be SMALL for all nuclear plants. The NRC staff identified no new and significant information regarding internal events during its review of FPL's environmental report, during the SAMA audit, through the scoping process, or through the evaluation of other available information. Thus, the NRC staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning offsite consequences of severe accidents initiated by internal events that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.2 External Events (Section E.3.2 of the 2013 GEIS)

Section E.3.2.3 of the 2013 GEIS concludes that the CDFs from severe accidents initiated by external events, as quantified in NUREG–1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," (NRC 1990) and other sources, are comparable to CDFs from accidents initiated by internal events but lower than the CDFs that formed the basis for the 1996 GEIS. In the 2013 GEIS, the environmental impacts from externally initiated events are generally significantly lower—one or more orders of magnitude lower—than the environmental impacts from external events determined in the 1996 GEIS.

The 1996 GEIS concluded that severe accidents initiated by external events (such as earthquakes, floods, or fires) could have potentially high consequences but also found that the risks from these external events are adequately addressed through a consideration of severe accidents initiated by internal events (such as a loss of cooling water). Therefore, the 1996 GEIS concluded that an applicant for license renewal need only analyze the environmental impacts from an internal event to characterize the environmental impacts from either internal or external events.

External Events: Seismic

In 2014, FPL performed a bounding seismic evaluation for Turkey Point using appropriate seismic hazard curves and a plant-level fragility curve. This bounding seismic evaluation demonstrated that the seismic risk at Turkey Point is not significant. By letter dated January 22, 2016 (NRC 2016b), the NRC staff documented its review of FPL's Turkey Point reevaluated seismic hazard, also referred to as the mitigating strategies seismic hazard information. The staff confirmed FPL's conclusion that the Turkey Point reevaluated seismic hazard is bounded by the current design basis at all frequencies above 1 Hertz (Hz). In addition, in the staff's letter of June 16, 2016, the staff concluded that the FPL-determined ground motion response spectrum adequately characterizes the reevaluated seismic hazard for the Turkey Point site (NRC 2016b). For more detail, see the NRC staff's June 16, 2016 letter, "Turkey Point Nuclear Generating, Unit Nos. 3 And 4—Staff Review of Mitigation Strategies Assessment Report of the Impact of the Reevaluated Seismic Hazard Developed in Response to the March 12, 2012, [10 CFR] 50.54(F) Letter (CAC Nos. MF7886 and MF7887)" (NRC 2016c). Thus, the NRC staff agrees with FPL's statement in its 2018 environmental report for Turkey Point subsequent license renewal, that Turkey Point does not require an updated seismic probabilistic risk assessment for subsequent license renewal.

External Events: Fire

By letter dated May 28, 2015, the NRC approved amendments modifying the Turkey Point Units 3 and 4 operating licenses and technical specifications to incorporate a new fire protection licensing basis in accordance with 10 CFR 50.48(c), “Fire Protection.” The amendments authorized the transition of Turkey Point’s fire protection program to a risk-informed and performance-based program based on the 2001 edition of National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (NRC 2015d]). FPL used the Fire PRA for consideration of the reduction in benefit for the fire-related SAMAs in the Turkey Point subsequent license renewal application environmental report.

In conclusion, there was a greater-than-a-factor-of-20 decrease in the Turkey Point internal events CDF and seismic risk for Turkey Point was determined to be insignificant. Therefore, the offsite consequences of severe accidents initiated by external events during the subsequent license renewal term would not exceed the impacts predicted in the GEIS. For these issues, the GEIS predicts that the impacts would be SMALL for all nuclear plants. The NRC staff identified no new and significant information regarding external events during its review of FPL’s environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff agrees with FPL’s conclusion that no new and significant information exists for Turkey Point concerning offsite consequences of severe accidents initiated by external events that would alter the conclusions reached in the 2013 GEIS or Turkey Point’s previous SAMA analysis.

E.3.3 New Source Term Information (Section E.3.3 of the 2013 GEIS)

The source term refers to the magnitude and mix of the radionuclides released from the fuel (expressed as fractions of the fission product inventory in the fuel), as well as their physical and chemical form, and the timing of their release following an accident. The 2013 GEIS concludes that, in most cases, more recent estimates give significantly lower release frequencies and release fractions than was assumed in the 1996 GEIS. Thus, the environmental impacts of radioactive materials released during severe accidents, used as the basis for the 1996 GEIS (i.e., the frequency-weighted release consequences), are higher than the environmental impacts that would be estimated today using more recent source term information. The staff also notes that results from the NRC’s State-of-the-Art Reactor Consequence Analysis (SOARCA) project (which represents a significant ongoing effort to re-quantify realistic severe accident source terms) confirm that source term timing and magnitude values calculated in the SOARCA reports are significantly lower than source term values quantified in previous studies. The NRC staff expects to incorporate the information gleaned from the SOARCA project in future revisions of the GEIS.

For the reasons described above, current source term timing and magnitude at Turkey Point is likely to be significantly lower than had been quantified in previous studies and the initial license renewal Turkey Point SAMA analysis in 2000. Therefore, the offsite consequences of severe accidents initiated with the new source term during the subsequent license renewal term would not exceed the impacts predicted in the GEIS. For these issues, the GEIS predicts that the impacts would be SMALL for all nuclear plants. The NRC staff identified no new and significant information regarding internal events during its review of FPL’s environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning offsite consequences of severe accidents initiated by internal events that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.4 Power Uprate Information (Section E.3.4 of the 2013 GEIS)

Operating at a higher reactor power level results in a larger fission product radionuclide inventory in the core than if the reactor were operating at a lower power level. In the event of an accident, the larger radionuclide inventory in the core would result in a larger source term. If the accident is severe, this larger source term could result in higher doses to offsite populations.

Large early release frequency (LERF) represents the frequency of sequences that result in early fatalities. The impact of a power uprate on early fatalities can be measured by considering the impact of the uprate on the LERF calculated value. To this end, Table E-14 of the 2013 GEIS presents the change in LERF calculated by each licensee that has been granted a power uprate of greater than 10 percent. As can be seen, the increase in LERF ranges from a minimal impact to an increase of about 30 percent (with a mean of 10.5 percent). The 2013 GEIS, Section E.3.4.3, "Conclusion," determines that power uprates will result in a small to (in some cases) moderate increase in the environmental impacts from a postulated accident. However, taken in combination with the other information presented in the GEIS, the increases would be bounded by the 95 percent upper confidence bound values in Table 5.10 and Table 5.11 of the 1996 GEIS.

In 2012, the NRC approved a 15 percent power uprate for Turkey Point, which included a 13 percent increase in core thermal power and a 1.7 percent measurement uncertainty recapture, from 2,300 megawatts thermal (MWt) to 2644 MWt. Before the extended power uprate, FPL calculated the Turkey Point Unit 4 internal events LERF to be 1.3×10^{-8}/year. After the extended power uprate, FPL conservatively projected the Unit 4 LERF to be 1.8×10^{-8}/year. This is a change of 4.3×10^{-9}/year, or an increase in LERF of about 32 percent. The NRC staff's safety evaluation for this extended power uprate at Turkey Point states that this increase in LERF falls within the acceptance guidelines for being "very small" (i.e., less than 1×10^{-7} per reactor year), set forth in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk Informed Decisions on Plant Specific Changes to the Licensing Basis," and therefore does not raise any concerns of adequate protection (NRC 2012). Accordingly, even though the change in LERF is slightly greater than 30 percent (upper percentage increase in LERF determined in the updated 2013 GEIS), the staff finds this change to be a very small impact due to the very small change in LERF as defined in RG 1.174.

In sum, the staff finds the conclusions of the 2013 GEIS on this topic appropriate for the Turkey Point subsequent license renewal application, considering that there was a "very small" (less than 1×10^{-7} per reactor year) change in LERF, the increases would be bounded by the 95 percent upper confidence bound values in Table 5.10 and Table 5.11 of the 1996 GEIS and Turkey Point had a greater-than-a-factor-of-20 decrease in the internal events CDF from the original SAMA to the subsequent license renewal application (which lowers the LERF). Therefore, the offsite consequences from the power uprate would not exceed the impacts predicted in the GEIS. For these issues, the GEIS predicted that the impacts would be SMALL to MODERATE for all nuclear plants. The NRC staff has identified no new and significant information regarding power uprates during its review of FPL's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning offsite consequences due to power uprates that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.5 Higher Fuel Burnup Information (Section E.3.5 of the 2013 GEIS)

According to the 2013 GEIS, increased peak fuel burnup from 42 to 75 gigawatt days per metric ton uranium (GWd/MTU) for PWRs, and 60 to 75 GWd/MTU for BWRs, results in small to moderate increases (up to 38 percent) in environmental impacts in the event of a severe accident. However, taken in combination with the other information presented in the 2013 GEIS, the increases would be bounded by the 95 percent upper confidence bound values in Table 5.10 and Table 5.11 of the 1996 GEIS.

FPL's environmental report, Section 2.2.1, "Reactor and Containment Systems," states that both Units 3 and 4 are licensed for fuel that is slightly enriched uranium dioxide (i.e., fuel that is up to 5 percent by weight uranium-235). FPL operates the reactors at an equilibrium core maximum fuel discharge burnup rate of 62 GWd/MTU (NRC 2018e). Therefore, the updated estimates of offsite consequences remained within the bounds of the 1996 GEIS evaluation (NRC 2013a).

Therefore, the offsite consequences from higher fuel burnup would not exceed the impacts predicted in the 2013 GEIS. For these issues, the GEIS predicted that the impacts would be SMALL for all nuclear plants. The NRC staff identified no new and significant information regarding higher fuel burnup during its review of FPL's environmental report, SAMA audit, the scoping process, or the evaluation of other available information. Thus, the staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning offsite consequences due to higher fuel burnup that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.6 Low Power and Reactor Shutdown Event Information (Section E.3.6 of the 2013 GEIS)

The 2013 GEIS concludes that the environmental impacts from accidents at low-power and shutdown conditions are generally comparable to those from accidents at full power, based on a comparison of the values in NUREG/CR–6143, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1," (NRC 1995a) and NUREG/CR–6144, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1," (NRC 1995b), with the values in NUREG–1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NRC 1990). The 1996 GEIS estimates of the environmental impact of severe accidents bound the potential impacts from accidents at low power and shutdown, with margin. There are no plant configurations in low power and shutdown conditions that would distinguish Turkey Point from the evaluated plants such that the assumptions in the 2013 and 1996 GEISs would not apply.

Finally, as discussed in SECY-97-168, "Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation" (NRC 1997), industry initiatives taken during the early 1990s have also contributed to the improved safety of low-power and shutdown operations for all plants. Therefore, the offsite consequences of severe accidents, considering low-power and reactor shutdown events, would not exceed the impacts predicted in the 1996 or 2013 GEIS. For these issues, the GEIS predicts that the impacts would be SMALL for all nuclear plants. The NRC staff identified no new and significant information regarding low-power and reactor shutdown events during its review of FPL's environmental report, through the NRC staff's SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning low-power and reactor shutdown events that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.7 Spent Fuel Pool Accident Information (Section E.3.7 of the 2013 GEIS)

The 2013 GEIS concludes that the environmental impacts from accidents involving spent fuel pools (as quantified in NUREG–1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" (NRC 2001)), can be comparable to those from reactor accidents at full power (as estimated in NUREG–1150 (NRC 1990)). Subsequent analyses performed, and mitigative measures employed since 2001, have further lowered the risk of this class of accidents. In addition, even the conservative estimates from NUREG–1738 are much lower than the impacts from full power reactor accidents estimated in the 1996 GEIS. Therefore, the environmental impacts stated in the 1996 GEIS bound the impact from spent fuel pool accidents for all plants. For these issues, the GEIS predicts that the impacts would be SMALL for all nuclear plants. There are no spent fuel configurations that would distinguish Turkey Point from the evaluated plants such that the assumptions in the 2013 and 1996 GEISs would not apply. The NRC staff identified no new and significant information regarding spent fuel pool accidents during its review of FPL's environmental report, the SAMA audit, the scoping process, or the evaluation of other available information. Thus, the NRC staff agrees with FPL's conclusion that no new and significant information exists for Turkey Point concerning spent fuel pool accidents that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.8 Use of Biological Effects of Ionizing Radiation (BEIR)-VII Risk Coefficients (Section E.3.8 of the 2013 GEIS)

In 2005, the NRC staff completed a review of the National Academy of Sciences report, "Health Risks from Exposure to Low Levels of Ionizing Radiation: Biological Effects of Ionizing Radiation (BEIR) VII, Phase 2" (BEIR VII 2005). The staff documented its findings in SECY-05-0202, "Staff Review of the National Academies Study of the Health Risks from Exposure to Low Levels of Ionizing Radiation (BEIR VII)" (NRC 2005a). The SECY paper states that the NRC staff agrees with the BEIR VII report's major conclusion—namely, the current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold, dose response relationship between exposure to ionizing radiation and the development of cancer in humans. The BEIR VII conclusion is consistent with the hypothesis on radiation exposure and human cancer that the NRC uses to develop its standards of radiological protection. Therefore, the NRC staff has determined that the conclusions of the BEIR VII report do not warrant any change in the NRC's radiation protection standards and regulations, which are adequately protective of public health and safety and will continue to apply during Turkey Point's subsequent license renewal term. This general topic is discussed further in the NRC's 2007 denial of Petition for Rulemaking (PRM)-51-11, which found no need to modify the 1996 GEIS in light of the BEIR VII report. For these issues, the GEIS predicts that the impacts of using the BEIR VII Risk Coefficients would be SMALL for all nuclear plants.

The NRC staff has identified no new and significant information regarding the risk coefficient used in the BEIR VII report during its review of FPL's environmental report, the SAMA audit, the scoping process, or the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Turkey Point concerning the biological effects of ionizing radiation that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.3.9 Uncertainties (Section E.3.9 of the 2013 GEIS)

Section 5.3.3 in the 1996 GEIS provides a discussion of the uncertainties associated with the analysis in the GEIS and in the individual plant EISs used to estimate the environmental impacts of severe accidents. The 1996 GEIS used 95th percentile upper confidence bound estimates whenever available for its estimates of the environmental impacts of severe accidents. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 GEIS. Many of these same uncertainties also apply to the analysis used in the 2013 GEIS update. As discussed in Sections E.3.1 through E.3.8 of the 2013 GEIS, the GEIS update used more recent information to supplement the estimate of environmental impacts contained in the 1996 GEIS. In effect, the assessments contained in Sections E.3.1 through E.3.8 of the 2013 GEIS provided additional information and insights into certain areas of uncertainty associated with the 1996 GEIS. However, as provided in the 2013 GEIS, the impact and magnitude of uncertainties, as estimated in the 1996 GEIS, bound the uncertainties introduced by the new information and considerations addressed in the 2013 GEIS. Accordingly, in the 2013 GEIS, the staff concluded that the reduction in environmental impacts resulting from the use of new information (since the 1996 GEIS analysis) outweighs any increases in impact resulting from the new information. As a result, the findings in the 1996 GEIS remain valid. The NRC staff has identified no new and significant information regarding uncertainties during its review of FPL's environmental report, the SAMA audit, the scoping process, or the evaluation of other available information. Accordingly, the NRC staff concludes that no new and significant information exists for Turkey Point concerning uncertainties that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

Section E.3.9.2 of Appendix E to the 2013 GEIS discusses the impact of population increases on offsite dose and economic consequences. The 2013 GEIS, in section E.3.9.2, states the following:

> The 1996 GEIS estimated impacts at the mid-year of each plant's license renewal period (i.e., 2030 to 2050). To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant's license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant's airborne and economic impacts from the year 2000 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5 to a 30 percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5 to 30 percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

Table 3.11-2 of Turkey Point's ER provides population information for the "County Populations Totally or Partially Included within a 50-Mile Radius of Turkey Point." As Table 3.11-2 shows, FPL estimates that in 2053 (i.e., at the end of the license renewal period for unit 4) the population within the 50-mile radius will be 6,890,445. Assuming a uniform increase in population, the mid-year population (2043) is projected to be 6,366,881 persons (37 percent higher than the U.S. Census Bureau data for the four counties in 2010). FPL's estimated population increase is slightly above the 30 percent range determined by the NRC in the 2013 GEIS to be not significant. However, as discussed in section E.3.3 of the 2013 GEIS and this

SEIS, more recent estimates give significantly lower release frequencies and release fractions for the source term than was assumed in the 1996 GEIS. Specifically, the 2013 GEIS states that “a comparison of population dose from newer assessments illustrates a reduction in impact by a factor of 5 to 100 when compared to older assessments, and an additional factor of 2 to 4 due to the conservatism built into the 1996 GEIS values.” Thus, the effect of this reduction in total dose from a radiological release following a severe accident far exceeds the effect of a population increase. The staff concludes that the effect of increased population around the plant does not result in significant increases in impacts. Thus, the staff concludes that no new and significant information exists for Turkey Point concerning population increase that would alter the conclusions reached in the 2013 GEIS or Turkey Point’s previous SAMA analysis.

E.3.10 Summary/Conclusion (Section E.5 of the 2013 GEIS)

The 2013 GEIS categorizes “sources of new information” by their potential effect on the best-estimate environmental impacts associated with postulated severe accidents. These effects can (1) decrease the environmental impact associated with severe accidents, (2) not affect the environmental impact associated with severe accidents, or (3) increase the environmental impact associated with severe accidents.

Areas of new and significant information that can result in the first effect (decrease the environmental impacts associated with severe accidents) at Turkey Point include:

- New internal events information (significant decrease)
- New source term information (significant decrease)

Areas of new and significant information that can result in the second effect (no effect on the environmental impact associated with severe accidents) or the third effect (increase the environmental impact associated with severe accidents) include:

- Use of BEIR VII risk coefficients
- Consideration of external events (comparable to internal event impacts)
- Spent fuel pool accidents (could be comparable to full-power event impacts)
- Higher fuel burnup (small to moderate increases)
- Low power and reactor shutdown events (could be comparable to full-power event impacts)
- Population Increase

The 2013 GEIS states, “Given the difficulty in conducting a rigorous aggregation of these results with the differences in the information sources utilized, a fairly simple approach is taken. The GEIS estimated the net increase from the first five areas listed above would be (in a simplistic sense) approximately an increase by a factor of 4.7. At the same time, however, for Turkey Point, the reduction in risk due to newer internal event information is a decrease in risk by a factor of 23. The net effect of an increase by a factor of 4.7 and a decrease by a factor of 23 would be overall lower estimated impact (as compared to the 1996 GEIS assessment) by a factor of 18.3. Thus, the staff finds that there is no new and significant information related to the severe accidents at Turkey Point that would alter the conclusions reached in the 2013 GEIS or Turkey Point’s previous SAMA analysis.

Other areas of new information relating to Turkey Point severe accident risk, severe accident environmental impact assessment, and cost-beneficial SAMAs are described below. These areas of new information demonstrate additional conservatism in the evaluations in the GEIS and FPL's ER, because they result in further reductions in the impact of a severe accident.

E.4 Other New Information Related to NRC Efforts to Reduce Severe Accident Risk Following Publication of the 1996 GEIS

The Commission has considered numerous ways to mitigate severe accidents, in addition to requiring a SAMA analysis at the time of initial license renewal, and has adopted various regulatory requirements for mitigating severe accident risks at reactor sites. In 1996, when it promulgated Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, the Commission explained in a *Federal Register* notice:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement (CPI) program…and the Commission has additional ongoing regulatory programs whereby licensees search for individual plant vulnerabilities to severe accidents and consider cost beneficial improvements (Final rule, Environmental review for renewal of nuclear power plant operating licenses, 61 FR 28467 (June 5, 1996)).

These "additional ongoing regulatory programs" that the Commission mentioned include the IPE (individual plant examination) and the IPEEE (individual plant examination of external events) program, which consider "potential improvements to reduce the frequency or consequences of severe accidents on a plant-specific basis and essentially constitute a broad search for severe accident mitigation alternatives." Further, the Commission observed that the IPEs "resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents". Based on these and other considerations, the Commission stated its belief that it is "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences" (61 FR 28481). The Commission noted that it may review and possibly reclassify the issue of severe accident mitigation as a Category 1 issue upon the conclusion of its IPE/IPEEE program, but deemed it appropriate to consider severe accident mitigation alternatives for plants for which had not done so previously, pending further rulemaking on this issue (61 FR 28481).

The Commission reaffirmed its SAMA-related conclusions in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 and 10 CFR 51.53(c)(3)(ii)(L), in *Exelon Generation Co., LLC* (Limerick Generating Station, Units 1 and 2), CLI-13-07, (Oct. 31, 2013) (ADAMS No. ML13304B417). In addition, the Commission observed that it had promulgated those regulations because it had "determined that one SAMA analysis would uncover most cost beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013d).

The NRC has continued to address severe accident-related issues since the agency published the GEIS in 1996. Combined NRC and licensee efforts have reduced risks from accidents beyond those that were considered in the 1996 GEIS. The 2013 GEIS describes many of those efforts (NRC 2013a). In some cases, such as the NRC's response to the accident at Fukushima, these activities are still ongoing. In the remainder of Section E.4 of this SEIS, the

NRC staff describes efforts to reduce severe accident risk (CDF and LERF) following publication of the GEIS in 1996. Each of these initiatives applies to all reactors, including Turkey Point Units 3 and 4. Section E.4.1 describes requirements adopted following the terrorist attacks in September 2001, to address the loss of large areas of a plant caused by fire or explosions. Section E.4.2 describes the SOARCA project, which indicates that source term timing and magnitude values may be significantly lower than source term values quantified in previous studies using other analysis methods. Section E.4.3 describes measures adopted following the Fukushima earthquake and tsunami events of 2013. Section E.4.4 discusses efforts that have been made to utilize plant operating experience to improve plant performance and design features. These are areas of new information that reinforce the conclusion that the probability-weighted consequences of a severe accident are SMALL for all plants, as stated in the 2013 GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at Turkey Point.

E.4.1 10 CFR 50.54(hh)(2) Requirements Regarding Loss of Large Areas of the Plant Caused by Fire or Explosions

As discussed on page E-7 of the 2013 GEIS, following the terrorist attacks of September 11, 2001, the NRC conducted a comprehensive review of the agency's security program and made further enhancements to security at a wide range of NRC-regulated facilities. These enhancements included significant reinforcement of the defense capabilities for nuclear facilities, better control of sensitive information, enhancements in emergency preparedness, and implementation of mitigating strategies to deal with postulated events potentially causing loss of large areas of the plant due to explosions or fires, including those that an aircraft impact might create. For example, the Commission issued Order EA-02-026, "Interim Compensatory Measures (ICM) Order." The ICM Order provided interim safeguards and security compensatory measure, and ultimately led to the promulgation of a new regulation in 10 CFR 50.54(hh). This regulation requires commercial power reactor licensees to prepare for a loss of large areas of the facility due to large fires and explosions from any cause, including beyond-design-basis aircraft impacts. In accordance with 10 CFR 50.54(hh)(2), licensees must adopt mitigation guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under circumstances associated with the loss of large areas of the plant due to explosion or fire.

NRC requirements pertaining to plant security are subject to NRC oversight on an ongoing basis under a plant's current operating license, and are beyond the scope of license renewal. As discussed in Section 5.3.3.1 of the 1996 GEIS, the NRC addresses security-related events using deterministic criteria in 10 CFR Part 73, "Physical Protection of Plants and Materials," rather than by risk assessments or SAMAs. However, the implementation of measures that reduce the risk of severe accidents, including measures adopted to comply with 10 CFR 50.54(hh), also have a beneficial impact on the level of risk evaluated in a SAMA analysis, the purpose of which is to identify potentially cost-beneficial design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents. . . Inasmuch as FPL has updated Turkey Point's guidelines, strategies, and procedures to meet the requirements of 10 CFR 50.54(hh), those efforts have contributed to mitigation of the risk of a beyond design basis event. Accordingly, actions taken by FPL to comply with those regulatory requirements have further contributed to the reduction of risk at Turkey Point.

In sum, the new information regarding actions taken by FPL to prepare for potential loss of large areas of the plant due to fire or explosions has further contributed to the reduction of severe accident risk at Turkey Point. Thus, this information does not alter the conclusions reached in the 2013 GEIS regarding the consequences of a severe accident or Turkey Point's previous SAMA analysis.

E.4.2 SOARCA

The 2013 GEIS notes that a significant NRC effort is ongoing to re-quantify realistic severe accident source terms under the State-of-the-Art Reactor Consequence Analysis (SOARCA) project. Preliminary results indicate that source term timing and magnitude values quantified using SOARCA may be significantly lower than source term values quantified in previous studies using other analysis methods (NRC 2008). The NRC staff plans to incorporate this new information regarding source term timing and magnitude using SOARCA in future revisions of the GEIS.

The NRC has completed a SOARCA study for Surry Nuclear Power Station. The Surry Nuclear Power Station is a Westinghouse 3-loop PWR similar to Turkey Point. The Surry SOARCA summary concludes that with SOARCA, the NRC has achieved its objective of developing a body of knowledge regarding detailed, integrated, state-of-the-art modeling of the more important severe accident scenarios for Surry. SOARCA analyses indicate that successful implementation of existing mitigation measures can prevent reactor core damage or delay or reduce offsite releases of radioactive material. All SOARCA scenarios, even when unmitigated, progress more slowly and release much less radioactive material than the potential releases cited in the 1982 Siting Study (NUREG/CR–2239, "Technical Guidance for Siting Criteria Development"). As a result, the calculated risks of public health consequences of severe accidents modeled in SOARCA are very small.

This new information regarding the SOARCA project's findings has further contributed to the reduction of the calculated severe accident risk at Turkey Point, as compared to the 1996 GEIS and the Turkey Point SAMA evaluation for the initial license renewal application in 2000. Thus, the NRC staff finds there is no new and significant information related to Turkey Point SAMAs that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.4.3 Fukushima-Related Activities

As discussed in Section E.2.1 of the 2013 GEIS, on March 11, 2011, a massive earthquake off the east coast of the main island of Honshu, Japan, produced a tsunami that struck the coastal town of Okuma in Fukushima Prefecture. This event damaged the six-unit Fukushima Dai-ichi nuclear power plant, causing the failure of safety systems needed to maintain cooling water flow to the reactors. Because of the loss of cooling, the fuel overheated, and there was a partial meltdown of fuel in three of the reactors. Damage to the systems and structures containing reactor fuel resulted in the release of radioactive material to the surrounding environment (NRC 2013a).

As further discussed in Section E.2.1 of the 2013 GEIS, in response to the earthquake, tsunami, and resulting reactor accidents at Fukushima Dai-ichi (hereafter referred to as the Fukushima events), the Commission directed the NRC staff to convene an agency task force of senior leaders and experts to conduct a methodical and systematic review of NRC regulatory requirements, programs, and processes (and their implementation) relevant to the Fukushima event. After thorough evaluation, the NRC required significant enhancements to U.S. commercial nuclear power plants. The enhancements included: adding capabilities to maintain key plant safety functions following a large-scale natural disaster; updating evaluations on the potential impact from seismic and flooding events; adding new equipment to better handle potential reactor core damage events; and strengthening emergency preparedness capabilities. Further information regarding this matter is presented in the 2013 GEIS and the NRC's Web site Fukushima-related actions at https://www.nrc.gov/reactors/operating/ops-experience/post-fukushima-safety-enhancements.html.

In sum, the Commission has imposed additional safety requirements on operating reactors following the Fukushima accident (as described in the preceding paragraphs). The new regulatory requirements contribute to the mitigation of the risk of a severe accident. Therefore, the NRC staff concludes there is no new and significant information related to the Fukushima events that would alter the conclusions reached in the 2013 GEIS or Turkey Point's previous SAMA analysis.

E.4.4 Operating Experience

Section E.2 of the 2013 GEIS mentions the considerable operating experience that supports the safety of U.S. nuclear power plants. As with the use of any technology, greater user experience generally leads to improved performance and, if applicable, improved safety. This additional experience has contributed to improved plant performance (e.g., as measured by trends in plant-specific performance indicators), a reduction in adverse operating events, and lessons learned that improve the safety of all the operating nuclear power plants. The items above contribute to improved safety as do those safety improvements not related to license renewal such as generic safety issues (e.g., Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Pump Performance"). Thus, the performance and safety record of nuclear power plants operating in the United States, including Turkey Point, continue to improve. This is also confirmed by analysis which indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency (NRC 2013a).

Conclusion

As discussed above, the NRC and the nuclear industry have addressed and continue to address numerous severe accident-related issues since the publication of the 1996 GEIS and the 2000 Turkey Point SAMA analysis. These actions reinforce the conclusion that the probability-weighted consequences of a severe accident are SMALL for all plants, as stated in the 2013 GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at Turkey Point.

E.5 Florida Power & Light's Evaluation of New and Significant Information Pertaining to SAMAs, Using NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA"

In its evaluation of the significance of new information, the NRC staff considers that new information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicates a given potentially cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or consequences (risk) of a severe accident occurring.

As discussed in Section E.2.2 above, FPL stated in its environmental report submitted as part of its subsequent license renewal application, that it used the methodology in NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA," dated June 29, 2017 (NEI 2017) to evaluate new and significant information as it relates to the Turkey Point subsequent license renewal SAMAs. By letter dated January 31, 2018, the staff reviewed NEI 17-04 and found it acceptable for interim use, pending formal NRC endorsement of NEI 17-04 by incorporation in Regulatory Guide 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications," (NRC 2018m). In general, as discussed above, the NEI 17-04 methodology (NEI 2017) does not consider a potential SAMA to be significant unless it reduces by at least 50 percent the maximum benefit as defined in Section 4.5, "Total Cost of Severe Accident Risk/Maximum Benefit," of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document."

NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA," describes a three-stage process for determining whether there is any "new and significant" information relevant to a previous SAMA analysis.

- **Stage 1**: The subsequent license renewal applicant uses PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with (1) all unimplemented "Phase 2" SAMAs for the analyzed plant and (2) those SAMAs identified as potentially cost beneficial for other U.S. nuclear power plants and which are applicable to the analyzed plant. If one or more of those SAMAs are shown to reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 2. (Applicants that are able to demonstrate through the Stage 1 screening process that there is no potentially significant new information are not required to perform the Stage 2 or Stage 3 assessments).
- **Stage 2**: The subsequent license renewal applicant develops updated averted cost-risk estimates for implementing those SAMAs. If the Stage 2 assessment confirms that one or more SAMAs reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 3.
- **Stage 3**: The subsequent license renewal applicant performs a cost-benefit analysis for the "potentially significant" SAMAs identified in Stage 2.

The following sections describe FPL's application of the NEI 17-04 methodology to Turkey Point SAMAs. FPL determined that none of the SAMAs evaluated in Stage 1 reduced the maximum benefit by 50 percent or more. As a result, FPL concluded it is not required to perform the Stage 2 or Stage 3 evaluations for any SAMAs.

E.5.1 Data Collection

NEI 17-04 Section 3.1, "Data Collection," explains that the initial step of the assessment process is to identify the "new information" relevant to the SAMA analysis and to collect and develop those elements of information that will be used to support the assessment. The guidance document states that each applicant should collect, develop, and document the information elements corresponding to the stage or stages of the SAMA analysis performed for the site. For Turkey Point subsequent license renewal, the NRC staff reviewed the onsite information during an audit at NRC headquarters and determined that FPL had considered the appropriate information (NRC 2018d).

E.5.2 Stage 1 Assessment

Section 4.15.3, "Methodology for Evaluation of New and Significant SAMAs," of FPL's environmental report describes the process it used for identifying any potentially new and significant SAMAs from the 2000 SAMA analysis (FPL 2018f). In Stage 1 of the process, FPL used PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with the following two types of SAMAs:

1) all unimplemented "Phase 2" SAMAs for Turkey Point
2) those SAMAs identified as potentially cost beneficial for other U.S. nuclear power plants and which are applicable to Turkey Point (FPL 2018f)

As discussed below, as a result of FPL's qualitative and quantitative Stage 1 screening, all potential SAMAs were found to reduce the maximum benefit by less than 50 percent, and they were therefore screened out from further evaluation. Therefore, Stage 2 of the NEI methodology was not entered, and an update of the Turkey Point Level 3 PRA was not needed.

E.5.3 Florida Power & Light's Evaluation of Unimplemented "Phase 2" SAMAs for Turkey Point

In 2000, FPL submitted an application for initial operating license renewal (FPL 2000), which the NRC approved in 2002. As part of that initial license renewal process, FPL performed a detailed evaluation of potential SAMAs, identifying 167 potential SAMAs. FPL then qualitatively screened out 93 of these potential SAMAs from further evaluation (for example, by screening out SAMAs that are only applicable to boiling water reactors), leaving 76 potential SAMAs. For these 76 SAMAs, FPL performed a detailed cost-benefit analysis (FPL 2000). The cost benefit analysis included development of a Level 3 probabilistic risk assessment (PRA) for Turkey Point Unit 3, which FPL used to calculate conditional offsite population doses and offsite economic consequences for each of the PRA source term categories (STCs). FPL developed the analysis for Turkey Point Unit 3, but it was applicable to the license renewal for both units (FPL 2000). By calculating the reduction in source term category frequencies for each potential SAMA, the present value dollar benefit of each SAMA was determined using the guidance of NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," (FPL 2000). FPL then compared the benefit to a cost estimate for each to complete the cost-benefit comparison. The conclusion reached by FPL in the SAMA analysis in its 2000 environmental report and by the NRC staff in its 2002 SEIS was that none of the analyzed Turkey Point SAMAs were potentially cost-beneficial.

As part of its subsequent license renewal application, FPL examined the Turkey Point probabilistic risk assessment again, for insights. The purpose was to determine if there was any new and significant information regarding the SAMA analyses that were performed to support issuance of the initial renewed operating licenses for Turkey Point. FPL re-evaluated the 76 SAMAs that were considered in connection with initial license renewal, using the NEI 17-04 process. Based on the Phase 1 qualitative and quantitative screening results, FPL found that all plant-specific and industry SAMAs were demonstrated to not be new and significant. Therefore, FPL concluded that there is no new and significant information that would alter the conclusions of Turkey Point's SAMA analysis for initial license renewal.

E.5.4 Florida Power & Light Evaluation of SAMAs Identified as Potentially Cost Beneficial at Other U.S. Nuclear Power Plants and Which Are Applicable to Turkey Point

The 2013 GEIS (NRC 2013a) considered the plant-specific supplemental EISs that document potential environmental impacts and mitigation measures for severe accidents relevant to license renewal for each plant. Some of these plant-specific supplements had identified potentially cost-beneficial SAMAs. FPL reviewed the SEISs of plants with a similar design to Turkey Point (large, dry PWR containment), to identify potentially cost-beneficial SAMAs. FPL qualitatively screened from further evaluation any SAMAs that were not applicable to Turkey Point, SAMAs that were already implemented at Turkey Point, and SAMAs that had excessive implementation costs. In this regard, FPL screened out SAMAs from further consideration if the initial license renewal review found that they reduced the Turkey Point maximum benefit by greater than 50 percent but were found not to be cost effective due to their high estimated costs of implementation. FPL grouped the remaining SAMAs based on similarities in mitigation equipment or risk reduction benefits. FPL then evaluated all the remaining SAMAs for the impact they would have assuming those SAMAs were implemented at Turkey Point.

Section 4.15.4.2 of FPL's subsequent license renewal environmental report provides the Turkey Point Stage 1 screening evaluation, using the methodology in NEI 17-04 "Model SLR New and Significant Assessment Approach for SAMA." FPL evaluated 76 Turkey Point-specific SAMAs and 263 potentially cost-beneficial SAMAs identified at similarly designed nuclear power plants (industry SAMAs). The SAMAs were related to both internal and external events. Qualitative screening resulted in elimination from further analysis of all external event SAMAs in the Turkey Point subsequent license renewal application, based on application of the screening criteria in section 3.2.1 of NEI 17-04. Qualitative screening of internal event SAMAs, along with binning of similar SAMAs, reduced the total number of SAMAs requiring further evaluation to 13. FPL binned the SAMAs in a manner that allowed bounding cases that completely addressed a plant risk contributor to be defined to estimate the maximum possible benefits for any of the grouped SAMAs. For example, all intersystem loss-of-coolant accident (ISLOCA)-related SAMAs could be represented by a single case in which all ISLOCA events are set to zero (i.e., the risk of an ISLOCA event was assumed to be completely eliminated by SAMA implementation). The NRC staff finds that this bounding approach provides a conservative analysis.

Table 4.15-1 of FPL's environmental report lists the 13 SAMAs identified by FPL as requiring a quantitative screening analysis, including the industry internal events SAMAs and the Turkey Point-specific SAMAs. FPL then performed quantitative screening using the full internal events Turkey Point Level 2 probabilistic risk assessment and the CDF/LERF portions of the fire and flood probabilistic risk assessments. Specifically, FPL quantitatively screened SAMAs if the bounding Turkey Point-specific case yielded a reduction of less than 50 percent in the frequency of each source term category group. As stated in Section 4.15.4.1 of the environmental report, the criterion for quantitative screening from further evaluation in the Stage 1 evaluation was that the SAMA does not reduce any source term category group frequency by at least 50 percent; if a SAMA was found to reduce at least one source term category group frequency by at least 50 percent, the SAMA would be evaluated in a Stage 2 assessment (as described in section E.5). In accordance with this approach, FPL performed the qualitative and quantitative Stage 1 screening, and determined that all potential SAMAs were screened out from further evaluation.

Since none of the SAMAs were found to reduce the maximum benefit by at least 50 percent, FPL determined that the SAMAs are not "potentially significant" and a Stage 2 assessment is not needed. Therefore, FPL concluded it was not required to proceed to a Stage 2 assessment for any SAMAs. As stated in NEI 17-04, “if a plant is able to demonstrate that none of the SAMAs evaluated in the Stage 1 assessment are potentially significant, then the Stage 2 inputs, such as the projected population within a 50-mile radius of the plant, should be listed as “new information”, but no work to estimate the actual 50-mile population is required.” Accordingly, consistent with NEI 17-04, there was no need for FPL to conduct a quantitative assessment of the effect of an increase in population numbers relative to the population considered in its initial license renewal SAMA analysis

The NRC staff reviewed Turkey Point’s onsite information and its SAMA identification and screening process, during an in-office audit at NRC headquarters (NRC 2018d). The staff found that FPL had used a methodical and reasonable approach to identify any SAMAs that might reduce the maximum benefit by at least 50 percent and therefore be considered to be potentially significant. Therefore, the NRC staff finds that FPL properly concluded, in accordance with the NEI 17-04 guidance, that a Stage 2 assessment was not needed.

E.5.5 Other New information

As discussed in FPL’s subsequent license renewal application environmental report and in NEI 17-04, there are some inputs to the SAMA analysis that are expected to change or to potentially change for all plants. These inputs include the following:

- Updated Level 3 PRA model consequence results, which may be impacted by multiple inputs, including, but not limited to, the following:
    - population, as projected within a 50-mile (80-km) radius of the plant
    - value of farm and nonfarm wealth
    - core inventory (e.g., due to power uprate)
    - evacuation timing and speed
    - Level 3 PRA methodology updates
    - cost-benefit methodology updates

In addition, other changes that could be considered to be new information may be dependent on plant activities or site-specific changes. These types of changes (listed in NEI 17-04) include the following:

- Identification of a new hazard (e.g., a fault that was not previously analyzed in the seismic analysis)
    - Updated plant risk model (e.g., a fire probabilistic risk assessment that replaces the individual plant examination of external events (IPEEE) analysis).
- Impacts of plant changes that are included in the plant risk models will be reflected in the model results and do not need to be assessed separately.
- Non-modeled modifications to the plant
    - Modifications determined to have no risk impact need not be included (e.g., replacement of the condenser vacuum pumps), unless they impact a specific input to SAMA (e.g., new low-pressure turbine in the power conversion system that results in a greater net electrical output)

Offsite consequence codes used in SAMA analyses consider plant-specific inputs as provided above. A detailed SAMA analysis would be able to analyze numerous plant-specific variables and the sensitivity of a SAMA analysis to these variables. However, inasmuch as a thorough

SAMA analysis was previously performed for Turkey Point's initial license renewal, a new SAMA analysis is not required by 51.53(c)(3)(ii)(L) and 10 CFR Part 51, Table B-1. Rather, as explained above, the licensee is required to consider new and significant information, i.e., new information that provides a seriously different picture of the consequences of the Federal action under consideration. With respect to SAMAs, new information may be significant if it indicated a SAMA would substantially reduce the probability or consequences of a severe accident.

The NEI methodology in NEI 17-04 uses "maximum benefit" to determine if SAMA-related information is new and significant. Maximum benefit (MB) is defined in Section 4.5 of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document," (NEI 2005), as the benefit a SAMA could achieve if it eliminated all risk. The total off-site dose and total economic impact are the baseline risk measures from which the maximum benefit is calculated. The NEI methodology in NEI 17-04 considers a SAMA to be potentially significant if it reduces the maximum benefit by at least 50 percent. The NRC staff finds the criterion of exceeding a 50-percent reduction in MB to be a reasonable significance threshold, because its correlates with the significance determination used in the ASME/ANS PRA standard, NUMARC 93-01, and NEI 00-04, all of which have been endorsed by the staff. It is also a reasonable quantification of the qualitative criterion for significance, which states that "new information is significant if it presents a seriously different picture of the impacts of the Federal action under consideration." Furthermore, it is consistent with the criterion that was accepted by the NRC staff in the Limerick Generating Station license renewal FSEIS.

In evaluating the guidance in NEI 17-04, the NRC staff found the 50-percent reduction approach described in NEI 17-04 to be reasonable because, with respect to SAMAs, the staff concluded that new information may be significant if it indicates a potentially cost-beneficial SAMA could substantially reduce the probability or consequences (risk) of a severe accident occurring. The implication of this statement is that "significance" is not solely related to whether a SAMA is cost beneficial (which may be affected by economic factors, increases in population, etc.), but depends also on a SAMA's potential to significantly reduce risk to the public.

E.5.6 Conclusion

As described above, FPL evaluated a total of 339 SAMAs for Turkey Point subsequent license renewal and did not find any SAMAs that would reduce the maximum benefit by 50 percent or more, and that further analysis was not required based on the guidance in NEI 17-04. The NRC staff reviewed FPL's evaluation and concludes that the methods used, and the results obtained, were reasonable. Based on Turkey Point's Phase 1 qualitative and quantitative screening results, FPL demonstrated that none of the plant-specific and industry SAMAs that it considered constitute new and significant information in that none changed the conclusion of Turkey Point's previous SAMA analysis. Further, the NRC staff has not identified any other new and significant information that would alter the conclusions reached in the previous SAMA analysis for Turkey Point. Therefore, the NRC staff finds no new and significant information that would alter the conclusions of the SAMA analysis performed for Turkey Point's initial license renewal.

The NRC staff reviewed FPL's new and significant information analysis for severe accidents and SAMAs at Turkey Point during the subsequent license renewal period and finds the analysis and the methods used to be reasonable. Given the low residual risk at Turkey Point, the substantial decrease in CDF at Turkey Point since the previous SAMA analysis, and the fact that no potentially cost-beneficial SAMAs were identified during the Turkey Point's initial license renewal review, the staff considers it unlikely that FPL would have found any potentially cost-beneficial SAMAs for subsequent license renewal. Further, FPL's implementation of actions to satisfy the NRC's orders and regulatory requirements regarding beyond-design-basis events after the 9/11 and Fukushima events, as well as the conservative assumptions used in earlier severe accident studies and SAMA analyses, also made it unlikely that FPL would have found any potentially significant cost-beneficial SAMAs during its subsequent license renewal review. For all of the reasons stated above, the NRC staff concludes that the conclusions reached by FPL in its subsequent license renewal environmental report regarding SAMAs are reasonable and that there is no new and significant information regarding any potentially cost-beneficial SAMA that would substantially reduce the risks of a severe accident at Turkey Point.

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10. SUPPLEMENTARY NOTES

D. Drucker

11. ABSTRACT (200 words or less)

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this draft supplemental environmental impact statement (SEIS) as part of its environmental review of Florida Power & Light Company's subsequent license renewal application, to renew the operating licenses for Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point) for an additional 20 years. This draft SEIS includes the NRC staff's preliminary evaluation of the environmental impacts of the subsequent license renewal as well as alternatives to subsequent license renewal. Alternatives to subsequent license renewal considered in this draft SEIS include: (1) a new nuclear power plant, (2) a new natural gas combined cycle power plant, and (3) the combination of a new natural gas combined cycle power plant and new solar photovoltaic power generation. In addition to replacement power alternatives, this draft SEIS evaluates an alternative cooling water system to mitigate potential impacts associated with the continued use of the existing cooling canal system. The NRC staff's preliminary recommendation is the adverse environmental impacts of subsequent license renewal for Turkey Point are not so great that preserving the option of subsequent license renewal for energy planning decisionmakers would be unreasonable.

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