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

NUREG-1941, Vol. 1

Draft Environmental Impact Statement for Combined Licenses (COLs) for Levy Nuclear Plant Units 1 and 2

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

U.S. Army Corps of Engineers
U.S. Army Engineer District, Jacksonville
Jacksonville, FL 32232-0019

US Army Corps

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Regulatory Branch
Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, FL 32232-0019

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For any additional information or copies of this draft, contact:

Mr. Douglas Bruner
Mail Stop T7-E18
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Phone: (301) 415-2730
Email: Douglas.Bruner@nrc.gov

or

Mr. Gordon A. Hambrick, III
Senior Project Manager
U.S. Army Corps of Engineers
Jacksonville District
1002 West 23rd Street, Suite 350
Panama City, Florida 32401
Phone: (850) 763-0717, ext. 25
Email: Gordon.A.Hambrick@usace.army.mil

Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the PEF application are (1) NRC issuance of COLs for two new power reactor units at the Levy Nuclear Plant (LNP) site in Levy County, Florida, and (2) U.S. Army Corps of Engineers (USACE) issuance of a permit to perform certain construction activities on the site. The USACE is participating in preparing this EIS as a cooperating agency and participates collaboratively on the review team (which comprises NRC staff, contractor staff, and USACE staff).

This EIS includes the review team's analysis that considers and weighs the environmental impacts of constructing and operating two new nuclear units at the LNP site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts.

The Federal Water Pollution Control Act (Clean Water Act) requires that the USACE apply the criteria set forth in the 404(b)(1) Guidelines in evaluating projects that propose to discharge dredged or fill material into waters of the United States. The USACE must also determine through its Public Interest Review (PIR) whether the proposed project is contrary to the public interest. The USACE permit decision, including its evaluation under the 404 Guidelines and the PIR, will be documented in the USACE Record of Decision, which will be issued following the issuance of the Final EIS. After considering the environmental aspects of the proposed action, the NRC staff's preliminary recommendation to the Commission is that the COLs be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by PEF; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

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Executive Summary

By letter dated July 28, 2008, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (combined licenses or COLs) for Levy Nuclear Plant (LNP) Units 1 and 2 located in southern Levy County, Florida. The review team's evaluation is based on the October 2009 revision to the application, responses to requests for additional information, and supplemental letters.

The proposed actions related to the LNP Units 1 and 2 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the LNP site, and (2) U.S. Army Corps of Engineers (USACE) issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act, (Clean Water Act) and Section 10 of the Rivers and Harbors Act to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency and participates collaboratively on the review team, which consists of NRC staff, contractor staff, and USACE staff. The reactor specified in the application is Revision 17 to the Westinghouse Electric Company, LCC AP1000 certified design.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) directs that an EIS be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

The purpose of PEF's requested NRC action – issuance of the COLs – is to obtain licenses to construct and operate two new nuclear units. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must also obtain and maintain permits from other Federal, State, Tribal, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of the PEF application is to determine if two nuclear units of the proposed design can be constructed and operated at the LNP site without unacceptable adverse impacts on the human environment. The purpose of PEF's requested USACE action is to obtain a permit to perform regulated activities that would affect waters of the United States.

Upon acceptance of the PEF application, NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent to prepare an EIS and conduct scoping. On December 4, 2008, the NRC held two public meetings in Crystal River, Florida, to obtain public input on the scope of the environmental review. The staff reviewed the oral testimony and written comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC and its contractors visited the Dixie, Putnam, and Highlands alternative sites in October 2008. In December 2008, the review team visited the LNP site and Crystal River alternative site. During the December 2008 site visit, the review team also conducted a site audit and met with PEF staff, public officials, and members of the public.

Included in this EIS are (1) the results of the NRC staff's analyses, which consider and weigh the environmental effects of the proposed action; (2) potential mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's preliminary recommendation regarding the proposed action.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance found in 40 CFR 1508.27. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels – SMALL, MODERATE, and LARGE:

> 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.

In preparing this EIS, the review team reviewed the application, including the Environmental Report (ER) submitted by PEF; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NRC's NUREG-1555, *Environmental Standard Review Plan – Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. In addition, the NRC staff considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

The NRC staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on (1) the application, including the ER submitted by PEF; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will issue its Record of Decision based, in part, on this EIS.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the environmental review. During this period, the NRC and USACE staff will conduct a public meeting near the LNP site to describe the results of the environmental review and accept public comments. All comments received during the comment period will be addressed in the final EIS.

The NRC staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the NRC's Safety Evaluation Report anticipated to be published in 2011.

Abbreviations/Acronyms

7Q10	the lowest average flow over a period of 7 consecutive days that occurs once every 10 years, on average
μS	micro Siemens
AADT	annual average daily traffic
ac	acre(s)
ACHP	Advisory Counsel of Historic Preservation
ADAMS	Agencywide Documents Access and Management System
ADM	average daily membership
ADT	average daily traffic
AEA	Atomic Energy Act of 1954
AFUDC	allowance for funds used during construction
ALARA	as low as reasonably achievable
a.m.	ante meridian
AO	archaeological occurence
AP1000	Westinghouse Electric Company, LLC AP1000 pressurized water reactor
APE	Area of Potential Effect
APT	Aquifer Performance Testing
AQCR	Air Quality Control Region
AQI	Air Quality Index
ASLB	Atomic Safety and Licensing Board
BA	biological assessment
BACT	Best Available Control Technologies
BDS	blowdown system
BEA	Bureau of Economic Analysis
BEBR	Bureau of Economic Business Research
BEIR	Biological Effects of Ionizing Radiation
bgs	below ground surface
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BP	Before Present
Bq	Becquerel(s)
BRA	Biological Research Associates
BRC	Bureau of Radiation Control (of the State of Florida Department of Health)
Btu	British thermal unit(s)
°C	degree(s) Celsius
CAA	Clean Air Act
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency

CEQ	Council on Environmental Quality
CESQG	conditionally exempt small quantity generator
CFBC	Cross Florida Barge Canal
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGP	Construction General Permit
CH2M Hill	CH2M Hill Nuclear Business Group
CHARTS	(Florida's) Community Health Assessment Resource Tool Set
Ci	curie(s)
cm	centimeter(s)
cm^3	cubic centimeter(s)
cm/s	centimeter(s) per second
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
COL	combined construction permit and operating license or combined license
CORMIX	Cornell Mixing Zone Expert System
Corps	U.S. Army Corps of Engineers
CP	construction permit
CPUE	catch per unit effort
CPI	Consumer Price Index
CR	County Road
CRDC	Crystal River Discharge Canal
CREC	Crystal River Energy Complex
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWIS	cooling-water intake structure
CWS	circulating-water system
d	day(s)
DA	Department of Army
dB	decibel(s)
dBA	decibel(s) (acoustic)
DBA	Design Basis Accident
DCD	Design Control Document
DHS	(Florida) Department of Human Services
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
D/Q	deposition values or factors
DSM	demand-side management
DTS	demineralized water-treatment system
DWRM2	District-Wide Regulation Model, Version 2
E&SCP	Erosion and Sediment Control Plan

EA	environmental assessment
EAB	exclusion area boundary
EDG	emergency diesel generator
EFH	essential fish habitat
EIA	Energy Information Administration or Economic Impact Area
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EMS	emergency management services
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
EPZ	emergency planning zone
ER	Environmental Report
ERP	Environmental Resource Permit
ESA	U.S. Endangered Species Act of 1973, as amended
ESO	Environmental Support Organization
ESP	early site permit
ESRP	Environmental Standard Review Plan
ESWEMS	Essential Service Water Emergency Makeup System
ESWS	Essential Service Water System

°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FAC	Florida Administrative Code
FAS	Floridan Aquifer System
FDA	U.S. Food and Drug Administration
FDACS	Florida Department of Agriculture and Consumer Service
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FDOE	Florida Department of Education
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FES	Final Environmental Statement
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FGT	Florida Gas Transmission Company
FIRM	Flood Insurance Rate Maps
FLUCFCS	Florida Land Use, Cover and Forms Classification System
FMP	fishery managemen plan
FNAI	Florida Natural Areas Inventory
fps	foot (feet) per second
FPSC	Florida Public Service Commission
FR	Federal Register
FRCC	Florida Reliability Coordinating Council

FS	Florida Statutes
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FTE	full-time equivalent (employee)
FVCOM	Finite Volume Community Ocean Model
FWDS	Fire Water Distribution System
FWPCA	Federal Water Pollution Control Act (aka Clean Water Act)
FWRI	Fish and Wildlife Research Institute
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s) (3)
GBq	gigabecquerel
GCC	global climate change
GCN	Greatest Conservation Need
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GI-LLI	gastrointestinal lower large intestine
GIS	geographic information system
gpd	gallon(s) per day
gph	gallon(s) per hour
gpm	gallon(s) per minute
gps	gallon(s) per second
GW(e)	gigawatt(s) electric
GWh	gigawatthour(s)
ha	hectare(s)
HAPC	Habitat Areas of Particular Concern
HAZMAT	hazardous material
HBS	historic basin storage
HDPE	high-density polyethylene
HLW	high-level waste
hr	hour(s)
hr/yr	hour(s) per year
HVAC	heating, ventilation, and air conditioning
Hz	hertz
I	Interstate
IAEA	International Atomic Energy Agency
IAQCR	Interstate Air Quality Control Region
IBA	Important Bird Area

ICRP	International Council on Radiological Protection
IEA	International Energy Agency
IGCC	integrated gasification combined cycle
in.	inch(es)
in./s	inch(es) per second
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	integrated resource planning
IRWST	in-containment refueling water storage tank
K-8	kindergarten through 8th grade
K–12	kindergarten through 12th grade
kcfs	thousand cubic feet per second
kg	kilogram(s)
KH	Kimley-Horn
kHz	kilo Hertz
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
kVA	kilovolt-ampere(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
kW(e)	Kilowatt electric
L	liter(s)
L/hr	liter(s) per hour
L/m	liter(s) per minute
lb	pound(s)
LC50	the concentration that is lethal to 50 percent of the sample population
LCFS	the transmission-line corridor from the proposed LNP to Central Florida South substation
LCR	the transmission-line corridor from the proposed LNP to the CREC 500-kV switchyard
Ld	daytime average noise levels
Ldn	day-night average noise level
LEDPA	least environmentally damaging practicable aternative
LLW	low-level waste
Ln	nighttime average noise levels
LNP	Levy Nuclear Plant
LNG	liquefied natural gas
LOAEL	Lowest Observed Adverse Effect Level
LOCA	loss-of-coolant accident
LOS	level of service
LPC	the transmission-line corridor from the proposed LNP to the proposed Citrus substation
Lpm	liter(s) per minute
LPZ	low population zone

LWA	limited work authorization
LWR	light water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mA	milliampere
MACCS(2)	Melcor Accident Consequence Code System
MBq	megabecquerel(s)
MBTA	Migratory Bird Treaty Act
µg	microgram(s)
mg	milligram(s)
MCL	maximum contaminant level
MEI	maximally exposed individual
MFL	minimum flows and levels
Mgd	million gallons per day
mG	milliGauss
mGy	milliGray(s)
MHW	mean high water
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
ml	milliliter(s)
MLU	Multi-Layer Unsteady state (model)
MMBtu	a thousand thousand British thermal units
mo	month
MOU	Memorandum of Understanding
mph	mile(s) per hour
mR	milliroentgen
mrad	millirad
mrem	millirem
MSA	Metropolitan Statistical Area
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSGP	Multi-Sector Generic Permit
msl	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s); also monitoring well
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)

N_2	nitrogen
NA	not applicable or data not available
NAAQS	National Ambient Air Quality Standards
NAGPRA	National American Graves Protection and Repatriation Act
NAVD88	Northern American Vertical Datum of 1988
NCRP	National Council on Radiation Protection and Measurements
NCI	National Cancer Institute
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOx	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission technical document
NWR	National Wildlife Refuge
OCA	Owner-Controlled Area
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation
OFW	Outstanding Florida Water(s)
OMHD	Office of Minority Health & Health Disparities
OSHA	Occupational Safety and Health Administration
OWR	Old Withlacoochee River
oz	ounce(s)
PAM	primary amoebic meningoencephalitis
PARS	Publicly Available Records System
PCB	polychlorinated biphenyl
pCi	picocuries
PCR	polymer chain reaction
PEF	Progress Energy Florida, Inc.
PEST	Model-Independent Parameter Estimation (code)
PIR	Public Interest Review
PK	preschool
p.m.	post meridian
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less

PMF	probable maximum flood
ppm	parts per million
PMP	probable maximum precipitation
PNNL	Pacific Northwest National Laboratory
ppm	part(s) per million
PPSA	Power Plant Siting Act
ppt	part(s) per thousandPPSA
PRA	probabilistic risk assessment
PSD	Prevention of Significant Deterioration
pss	practical salinity scale
psu	practical salinity unit
PWS	potable water system
R	roentgen(s)
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCS	reactor coolant system
rem	roentgen equivalent man (a special unit of radiation dose)
REMP	radiological environmental monitoring program
RFAI	Reservoir Fish Assemblage Index
RIMS	Regional Input-Output Modeling System
RLE	Required Local Effort
RM	river mile
ROD	Record of Decision
ROI	region of influence or region of interest
ROW	Rights-of-way(s)
RV	recreational vehicle
Ryr	reactor-year
RWS	raw water system
µS	microsievert(s)
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternatives
SAMDA	severe accident mitigation design alternatives
SAR	Safety Analysis Report
SAS	surficial aquifer system
SCA	Site Certification Application
SCL	straight carpace length
SCR	selective catalytic reduction
SDS	sanitary drainage system
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SFWMD	South Florida Water Management District
SG	steam generator

SHGW	seasonal high groundwater
SHPO	State Historic Preservation Office or Officer
SHWL	seasonal high-water level
SJRWMD	St. Johns River Waste Management District
SMZ	Streamside Management Zone
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCC	spill prevention, control, and countermeasures
SQG	small quantity generator
SR	State Route
SRWMD	Suwannee River Water Management District
SSC	structures, systems, or components
SU	Standard Unit
Sv	sievert(s)
SWA	Small Wild Area
SWAPP	Source Water Assessment and Protection Program
SWFWMD	Southwest Florida Water Management District
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s)
Tarmac	Tarmac America, LLC
TBD	to be determined
TBq	terabecquerel(s)
T&E	threatened and endangered
TCP	traditional cultural property
TDS	total dissolved solids
TEDE	total effective dose equivalent
TIGER	Topologically Integrated Geographic Encoding and Referencing
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
TRAGIS	Transportation Routing Analysis Geographical Information System
TRU	transuranic (elements)
TSS	total suspended solids
µm	micrometer(s) or micron(s)
U-235	uranium-235
U-238	uranium-238
U_3O_8	triuranium octoxide ("yellowcake")
UF_6	uranium hexafluoride
UFA	Upper Floridan Aquifer
UHS	ultimate heat sink
UMAM	Uniform Mitigation Assessment Methodology
UMTRI	University of Michigan Transportation Research Institute

UO_2	uranium dioxide
US	U.S. Highway
U.S.	United States
USACE	U.S. Army Corps of Engineers (or Corps)
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Company, LLC
WHO	World Health Organization
WIC	(Citrus County) Women-Infant-Children (Program)
WMA	Wildlife Management Area
WRB	wastewater-retention basin
WTE	waste-to-energy (plant)
WWS	wastewaster system
χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
XOQDOQ	computer program for the meteorological evaluation of routine effluent releases at nuclear power plants
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

1.0 Introduction

By letter dated July 28, 2008, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (COLs) for Levy Nuclear Plant (LNP) Units 1 and 2 (PEF 2008a). The NRC review team's evaluation is based on the October 2009 revision of the application (PEF 2009), responses to requests for additional information, and supplemental information. Documents supporting the review team's evaluation are listed as references where appropriate.

The location for proposed LNP Units 1 and 2 is a greenfield site in Levy County, Florida, 7.9 mi east of the Gulf of Mexico and 30.1 mi west of Ocala, Florida. The proposed Units 1 and 2 would be completely within the confines of PEF's LNP site. In its application, PEF specified the reactor design as the Westinghouse Electric Company, LLC (Westinghouse) AP1000 pressurized water reactor (PEF 2009).

On June 2, 2008, PEF submitted a Site Certification Application to the State of Florida Department of Environmental Protection (PEF 2008b). The U.S. Army Corps of Engineers (USACE) received a copy of this application on June 30, 2008. In its March 16, 2009 Public Notice (USACE 2009), the USACE stated that the Environmental Resource Permit application contained in the Site Certification Application, along with its supporting documents, make up the Department of Army (DA) permit application for the USACE's evaluation of regulated impacts to waters of the United States. Conditions of Certification for LNP Units 1 and 2, associated facilities, and transmission lines were issued by the State of Florida on August 26, 2009, and were subsequently modified on January 12, 2010 and February 23, 2010 (FDEP 2010). The USACE is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency.

PEF's application for LNP Units 1 and 2 seeks (1) NRC issuance of COLs for construction and operation of two new nuclear units at the LNP site, and (2) USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act of 1899. The permit application requests authorization to affect waters of the United States, including approximately 765 ac of wetlands to construct the LNP electrical generation facility, and various associated, integral project components, including electrical transmission lines and substations, access roads, a barge slip, blowdown pipelines, a make-up water pipeline, and cooling water intake structure.

1.1 Background

A COL is a Commission approval for the construction and operation of a nuclear power facility. The NRC regulations related to COLs are primarily found in Title 10 of the U.S. Code of Federal Regulations (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321, et seq.) requires the preparation of an EIS for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented NEPA in 10 CFR Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

According to 10 CFR 52.80(b), a COL application must contain an Environmental Report (ER). The ER provides the applicant's input to the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51. PEF's ER, which is included as Part 3 of the application, provides a description of the proposed actions related to the application and PEF's analysis of the potential environmental impacts of construction and operation of proposed Units 1 and 2.

1.1.1 Application and Review

The purpose of the PEF application is to obtain COLs to construct and operate two baseload nuclear power reactors. In addition to the COLs, PEF must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of the action PEF has requested from USACE is to obtain a permit to perform regulated activities that would affect waters of the United States. Collectively, the NRC staff (including its contractor staff at Pacific Northwest National Laboratory and Information Systems Laboratories) and USACE staff who reviewed the ER and decided on impact levels are referred to as the "review team" throughout this EIS.

1.1.1.1 NRC COL Application Review

PEF's ER focuses on the environmental effects of construction and operation of two Westinghouse AP1000 pressurized water reactors (PEF 2009). The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81. Detailed procedures for conducting the environmental portion of the review are found in guidance set forth in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (ESRP) (NRC 2000) and recent updates, hereafter referred to as the ESRP.

In this EIS, the review team evaluates the environmental effects of constructing and operating two AP1000 reactors at the LNP site, including the exemptions and departures from the AP1000 Design Control Document requested by PEF in Part 7 of its application, each with a core power rating of 3400 MW(t). The new units would use a closed-cycle, wet-cooling system that uses mechanical draft cooling towers for heat dissipation.

In addition to considering the environmental effects of the proposed action, the NRC considers alternatives to the proposed action, including the no-action alternative and approval to construct and operate new reactors at alternative sites. Also, the benefits of the proposed action (e.g., need for power) and measures and controls to limit adverse impacts are evaluated.

Upon acceptance of PEF's application, the NRC began the environmental review process by publishing in the *Federal Register* on October 24, 2008, a Notice of Intent to prepare an EIS and conduct scoping (73 FR 63517). On December 4, 2008, the NRC held two public scoping meetings in Crystal River, Florida, to obtain public input on the scope of the environmental review. The NRC staff also contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the agencies and organizations contacted is provided in Appendix B. The NRC staff reviewed the comments received during scoping and responses were written for each comment. Comments within the scope of the NRC environmental review and their associated responses are included in Appendix D. A complete list of the scoping comments and responses is documented in the *Levy Nuclear Plant Combined License Scoping Summary Report* (NRC 2009).

To gather information and to become familiar with the sites and their environs, the NRC and its contractors visited the Dixie, Putnam, and Highlands alternative sites in October 2008. In December 2008, the review team visited the LNP site and the Crystal River alternative site. During the December 2008 site visit, the review team met with PEF staff, public officials, and the public. Documents related to the LNP site and alternative sites were reviewed and are listed as references where appropriate.

To guide its assessment of the environmental impacts of the proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC – SMALL, MODERATE, and LARGE:

> 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.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the LNP site including the environmental impacts associated with constructing and operating reactors at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's preliminary recommendation to the Commission regarding the issuance of COLs for the proposed Units 1 and 2 at the LNP site.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency (EPA) Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the NRC and USACE staffs' review. A public meeting will be held near the site during the EIS comment period. This meeting will also serve as the USACE public hearing to acquire information or evidence that will be considered in evaluating a proposed DA permit. During this public meeting, members of the review team will describe the results of the environmental review, provide members of the public with information to assist them in formulating comments on the EIS and accept comments on the EIS. After the comment period, the review team will consider all comments and address them in the final EIS.

1.1.1.2 USACE Permit Application Review

The USACE is a cooperating agency with the NRC serving as the lead agency in the development of this EIS, and has participated as a member of the review team. In carrying out its regulatory responsibilities, the USACE will complete an independent evaluation of the applicant's DA permit application to determine whether to issue or deny a DA permit for this project. This decision will be documented in the USACE's Record of Decision (ROD), which will be issued after publication of the Final EIS.

USACE's ROD will reference information in the EIS and present any additional information required by the USACE to support its permit decision. The USACE's role as a cooperating agency in the preparation of this EIS is to ensure to the maximum extent practicable that the information presented is adequate to fulfill the requirements of USACE regulations. The Clean Water Act, Section 404(b)(1) "Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (40 CFR Part 230), contains the substantive environmental criteria used by USACE in evaluating discharges of dredged or fill material into waters of the United States. USACE's Public Interest Review (PIR) (33 CFR 320.4) directs the USACE to consider a number of factors as part of a balanced evaluation process. USACE's PIR will be part of its permit decision document and will not be addressed in this EIS.

As part of the USACE public comment process, USACE released a public notice on March 16, 2009, to solicit comments from the public about PEF's proposed preconstruction activities at the LNP site (USACE 2009). Upon release of the draft EIS, USACE will issue a second public notice that will include notification for the joint USACE public hearing and NRC public meeting.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations (LWAs) for Nuclear Power Plants" (72 FR 57416), the Commission limited the definition of "construction" to those activities within its regulatory purview in 10 CFR 51.4. Many of the activities required to construct a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the review of a COL application, or after a COL is granted. Although preconstruction activities are outside of NRC's regulatory authority, nearly all of them are within the regulatory authority of local, State, or other Federal agencies.

Because the preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities that require permits from USACE are considered to have direct effects related to its Federal permitting decision. Chapter 4 describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.3 Cooperating Agencies

NEPA lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have special expertise regarding an environmental issue or jurisdiction by law. These other agencies, referred to as "cooperating agencies," are responsible for assisting the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis and by making staff support available as needed by the lead agency.

In addition to a license from the NRC, most proposed nuclear power plants require a permit from USACE when impacts on waters of the United States are proposed. Therefore, the NRC and the USACE decided that the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, NRC and USACE signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (USACE and NRC 2008). Therefore, the Jacksonville District of USACE is participating as a cooperating agency as defined in 10 CFR 51.14.

As described in the MOU, the NRC is the lead Federal agency, and the USACE is a cooperating agency in the development of the EIS for proposed LNP Units 1 and 2. Under Federal law, each agency has jurisdiction related to portions of the proposed project as major Federal actions that could significantly affect the quality of the human environment. The goal of this cooperative agreement is the development of one EIS that serves the needs of the NRC license decision process and the USACE permit decision process. While both agencies must meet the requirements of NEPA, they also have mission requirements that must be met in addition to the NEPA requirements. NRC makes license decisions under the Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.), and USACE makes permit decisions under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. USACE is cooperating with NRC to ensure to the maximum extent practicable that the information presented in the NEPA documentation is adequate to fulfill the requirements of USACE regulations; Clean Water Act Section 404(b)(1) guidelines, which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE PIR process.

As a cooperating agency, USACE is part of the NRC review team and is involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. For the purpose of assessing environmental impacts under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1 of this EIS. This approach has been vetted by the Council on Environmental Quality when the NRC established its environmental review framework for the renewal of operating licenses. However, for permit decisions under Section 404 of the Clean Water Act, USACE can only permit the least environmentally damaging practicable alternative and must address public interest factors. The EIS is intended to provide information to support the USACE permitting decision, as will be documented in USACE's Record of Decision. The goal of the process is for USACE to have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible that USACE will need additional information from the applicant to complete the permit documentation; for example, information that the applicant could not make available by the time the final EIS is issued. Also, any conditions required by USACE, such as implementation of additional mitigative measures, would be required by a permit if issued by USACE.

1.1.4 Concurrent NRC Reviews

In reviews that are separate but parallel to the EIS process, the NRC staff analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a Safety Evaluation Report (SER) issued by NRC. The SER presents the conclusions reached by NRC regarding (1) whether there is reasonable assurance that two AP1000 reactors can be constructed and operated at the LNP site without undue risk to the health and safety of the public; (2) whether the PEF emergency preparedness program for LNP meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73 and 10 CFR Part 100; and (3) whether site characteristics are such that adequate security plans and measures referenced in the regulations identified above can be developed. The final SER for the PEF COL application is expected to be published in 2011.

The reactor design referenced in PEF's COL application for LNP Units 1 and 2 is Revision 17 to the AP1000 certified design (Westinghouse 2008). Westinghouse submitted Revision 17 to the AP1000 Design Certification Amendment on September 22, 2008, and it is currently undergoing NRC review. Subpart B of 10 CFR Part 52 contains NRC regulations related to standard design certification. An application for a standard design certification undergoes an extensive review. Revision 15 of the AP1000 design is codified in 10 CFR Part 52, Appendix D. The NRC staff is currently reviewing Revision 17. Where appropriate, this EIS incorporates results of the review of Revision 15 and insights from the ongoing review of Revision 17. If the final design is different from the design considered in the EIS, the NRC staff will determine whether the changes are significant enough to warrant an additional environmental review.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs authorizing the construction and operation of two new Westinghouse AP1000 reactors at the LNP site. This EIS provides the NRC staff's analyses of the environmental impacts that could result from building and operating the two proposed units at the LNP site or at one of the four alternative sites. These impacts are analyzed by NRC to determine whether the proposed site is suitable for the two units and whether any of the alternative sites are considered to be obviously superior to the proposed site. The proposed USACE Federal action is the decision whether to issue a permit pursuant to the requirements in Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 to authorize certain activities potentially affecting waters of the United States based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activities on the public interest. If issued, the USACE permit would authorize the impact in waters of the United States, including wetlands, for the construction of the LNP electrical generation facility, and various associated, integral project components, including electrical transmission lines and substations, access roads, a barge slip, blowdown pipelines, a make-up water pipeline, and cooling water intake structure. The barge slip, makeup-water-intake structure, and blowdown-discharge structure would be located in navigable waters.

1.3 Purpose and Need for the Proposed Actions

The continued growth of residential and commercial development in Florida has created an increased demand for electrical power. The purpose and need of this proposed action – authorization of the construction and operation of two AP1000 units at the LNP site – is to provide additional baseload electrical generation capacity for use in the PEF service territory. The need for additional baseload power is discussed in Chapter 8 of this EIS.

Two COLs from the NRC are needed to construct and operate proposed LNP Units 1 and 2. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. PEF must obtain and maintain permits or authorizations from other Federal, State, and local agencies, and permitting authorities before undertaking certain activities. The ultimate decision whether or not to build the new units and the schedule for building them are not within the purview of NRC or USACE and would be determined by the license holder if the authorizations are granted.

Under the Section 404(b)(1) Guidelines, USACE determines both a basic and an overall project purpose. Defining the basic project purpose enables USACE to determine whether the activity is water dependent (40 CFR 230.10(a)(3)). The overall project purpose is used to identify and evaluate practicable alternatives (40 CFR 230.10(a)(2)).

For this project, USACE has determined the following purpose and need statements:

- Basic Purpose – To meet the public's need for electric energy.
- Overall Purpose – To meet the public's need for reliable increased electrical baseload generating capacity in Progress Energy Florida's service territory.

For the USACE's NEPA review, the overall project purpose is consistent with that the purpose and need for the proposed NRC action.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 9 of this EIS addresses the following five categories of alternatives to the proposed action: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, (4) system design alternatives, and (5) onsite alternatives to reduce impacts on natural and cultural resources.

In the no-action alternative, the proposed action would not proceed. The NRC could deny PEF's request for the COLs. If the request was denied, construction and operation of the two new units at the LNP site would not occur and any benefits intended by the approved COLs would not be realized. Energy source alternatives focus on those alternatives that could generate baseload power. The alternative selection process to determine alternate site locations for comparison with the LNP site is addressed below. System design alternatives include heat-dissipation and circulating-water systems, intake and discharge structures, and water-use and -treatment systems. In its ER (PEF 2009), PEF defines a region of interest for use in identifying and evaluating potential sites for power generation. Using this process, PEF reviewed multiple sites and identified eight candidate sites for this project from which the alternative sites were selected. The NRC staff evaluated the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of new power reactors at those sites using reconnaissance-level information in accordance with ESRP 9.3 (NRC 2000). Reconnaissance-level information is data that are readily available from agencies and other public sources and also can include information obtained through visits to the site area. The alternative sites include one site owned by PEF and three other sites. The site owned by PEF is the site of Crystal River Unit 3, an existing nuclear power reactor located in Citrus County, Florida. The other alternative sites are Dixie, located in Dixie County, Florida; Highlands, located in Highlands and Glades counties, Florida; and Putnam, located in Putnam County, Florida. The objective of the comparison of environmental impacts is to determine if any of the alternative sites are obviously superior to the LNP site.

In evaluating permit applications under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act, USACE is required to consider alternatives in the context of the applicant's purpose and need for the project, as well as the purpose and need from a public interest perspective. USACE is required by regulation to apply the criteria set forth in the 404(b)(1) Guidelines (33 USC 1344; 40 CFR Part 230). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404. These guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have a less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences (40 CFR 230.10(a)).

1.5 Compliance and Consultations

Before building and operating new units, PEF is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. In its ER (PEF 2009), PEF provided a list of environmental approvals and consultations associated with proposed LNP Units 1 and 2. Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H. In the development of this EIS, the NRC contacted the appropriate Federal, State, Tribal, and local agencies to identify any consultation, compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the LNP site for building and operating the two proposed AP1000 units. A chronology of the correspondence is provided in Appendix C. A list of key consultation correspondence is provided in Appendix F, which also contains biological assessments and an essential fish habitat assessment.

1.6 References

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."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

10 CFR Part 73. Code of Federal Regulations, Title 10, *Energy*, Part 73, "Physical Protection of Plants and Materials."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 320, "General Regulatory Policies."

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, "Guidelines for Specification of Disposal Sites for Dredged or Fill Material."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

72 FR 57416. October 9, 2007. "Limited Work Authorizations for Nuclear Power Plants." *Federal Register*. U.S. Nuclear Regulatory Commission.

73 FR 63517. October 24, 2008. "Progress Energy Florida, Inc.; Levy Nuclear Power Plant, Units 1 and 2, Combined License Application and Limited Work Authorization; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*. U.S. Nuclear Regulatory Commission.

Atomic Energy Act of 1954. 42 USC 2011, et seq.

Federal Water Pollution Control Act of 1972 (also referred to as Clean Water Act). 33 USC 1251, et seq.

Florida Department of Environmental Protection (FDEP). 2010. *Levy Nuclear Power Plant, Units 1 & 2, Progress Energy Florida, PA08-51B Conditions of Certification, Plant and Associated Facilities and Transmission Lines*. Tallahassee, Florida.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

Progress Energy Florida, Inc. (PEF). 2008a. *Application for Combined License for Levy Nuclear Power Plant Units 1 and 2; NRC Project Number 756.* Raleigh, North Carolina. Revision 0. Accession No. ML082260277.

Progress Energy Florida, Inc. (PEF). 2008b. *Levy Nuclear Plant Units 1 and 2, Site Certification Application, Volumes 1 through 9*. St. Petersburg, Florida. Including Amendments and Supplemental Information. Available at http://www.dep.state.fl.us/siting/apps.htm#ppn1.

Progress Energy Florida, Inc. (PEF). 2009. *Application for Combined License for Levy Nuclear Power Plant Units 1 and 2; NRC Project Number 756*. St. Petersburg, Florida. Revision 1. Accession No. ML092860397.

Rivers and Harbors Appropriation Act of 1899, as amended. 33 USC 403, et seq..

U.S. Army Corps of Engineers (USACE). 2009. *Public Notice – Permit Application No. SAJ-2008-490 (IP-GAH); Levy Nuclear Plant (LNP) – Progress Energy Florida, SAJ-2008-490 (IP-GAH), Sheet Index/Explanation for Public Notice*. Panama City, Florida. Accession No. ML090890419.

U.S. Army Corps of Engineers and U.S. Nuclear Regulatory Commission (USACE and NRC). 2008. *Memorandum of Understanding: Environmental Reviews Related to the Issuance of Authorizations to Construct and Operate Nuclear Power Plants*. September 12, 2008. Accession No. ML082540354.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan – Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555, Vol. 1, Washington, D.C. Includes 2007 revisions.

U.S. Nuclear Regulatory Commission (NRC). 2009. *Scoping Summary Report Related to the Environmental Scoping Process for the Levy Nuclear Power Plant, Units 1 and 2, Combined License Application*. Washington, D.C. May 28, 2009. Accession No. ML091260469.

Westinghouse Electric Company LLC (Westinghouse). 2008. *AP1000 Design Control Document*. APP-GW-GL-700, Revision 17, Pittsburgh, Pennsylvania. Accession No. ML083230868.

2.0 Affected Environment

The site proposed by Progress Energy Florida, Inc. (PEF) is a greenfield site located in Levy County, Florida. The site is located 7.9 mi east of the Gulf of Mexico and 30.1 mi west of Ocala, Florida. The location of proposed Levy Nuclear Plant (LNP) Units 1 and 2 is described in Section 2.1, followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, nonradiological health, and radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects and consultations, and references are listed in Section 2.13.

2.1 Site Location

PEF's location for proposed LNP Units 1 and 2 in relationship to the counties, cities, and towns within a 50-mi radius of the site is shown in Figure 2-1. Figure 2-2 shows additional details within a 6-mi radius of the site for proposed LNP Units 1 and 2. The nearest population centers that have more than 25,000 residents are Ocala, Florida, (30.1 mi east) and Gainesville, Florida (44.2 mi northeast). The LNP site, consisting of 3105 ac as depicted in Figure 2-3, is generally bounded by U.S. Highway 19 (US-19) on the west and the Goethe State Forest on the north. A common corridor will extend south from the LNP site boundary to the Cross Florida Barge Canal (CFBC), which would include offsite facilities that would support LNP Units 1 and 2 and transmission lines. The Withlacoochee River, Lake Rousseau (an impounded section of the Withlacoochee River), Inglis Lock bypass channel, and a section of the CFBC are approximately 3 mi south of the site and run roughly parallel to the site's southern border. The community of Inglis is located approximately 4.1 mi southwest of the LNP site. The Crystal River Energy Complex (CREC), an energy facility also owned by PEF, is located approximately 9.6 mi southwest of the LNP site.

2.2 Land Use

This section discusses existing conditions related to land-use issues on and in the vicinity (i.e., the area encompassed within a radius of 6 mi) of the LNP site. Section 2.2.1 describes the site and vicinity. Section 2.2.2 discusses the existing and proposed transmission-line corridors. Section 2.2.3 discusses the region, defined as the area within 50 mi of the LNP site boundary.

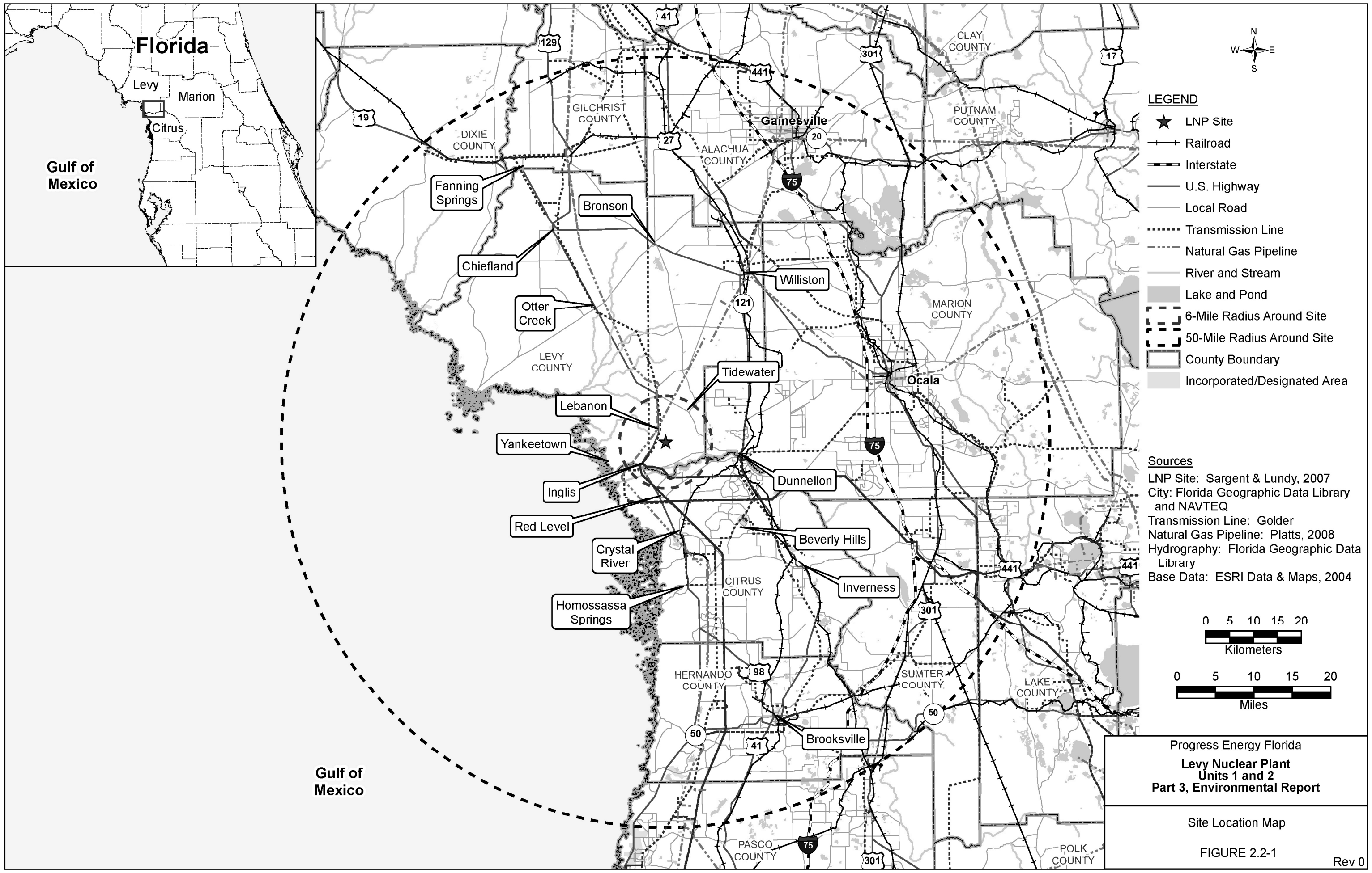


Figure 2-1. LNP Site Location and Region (PEF 2009a)

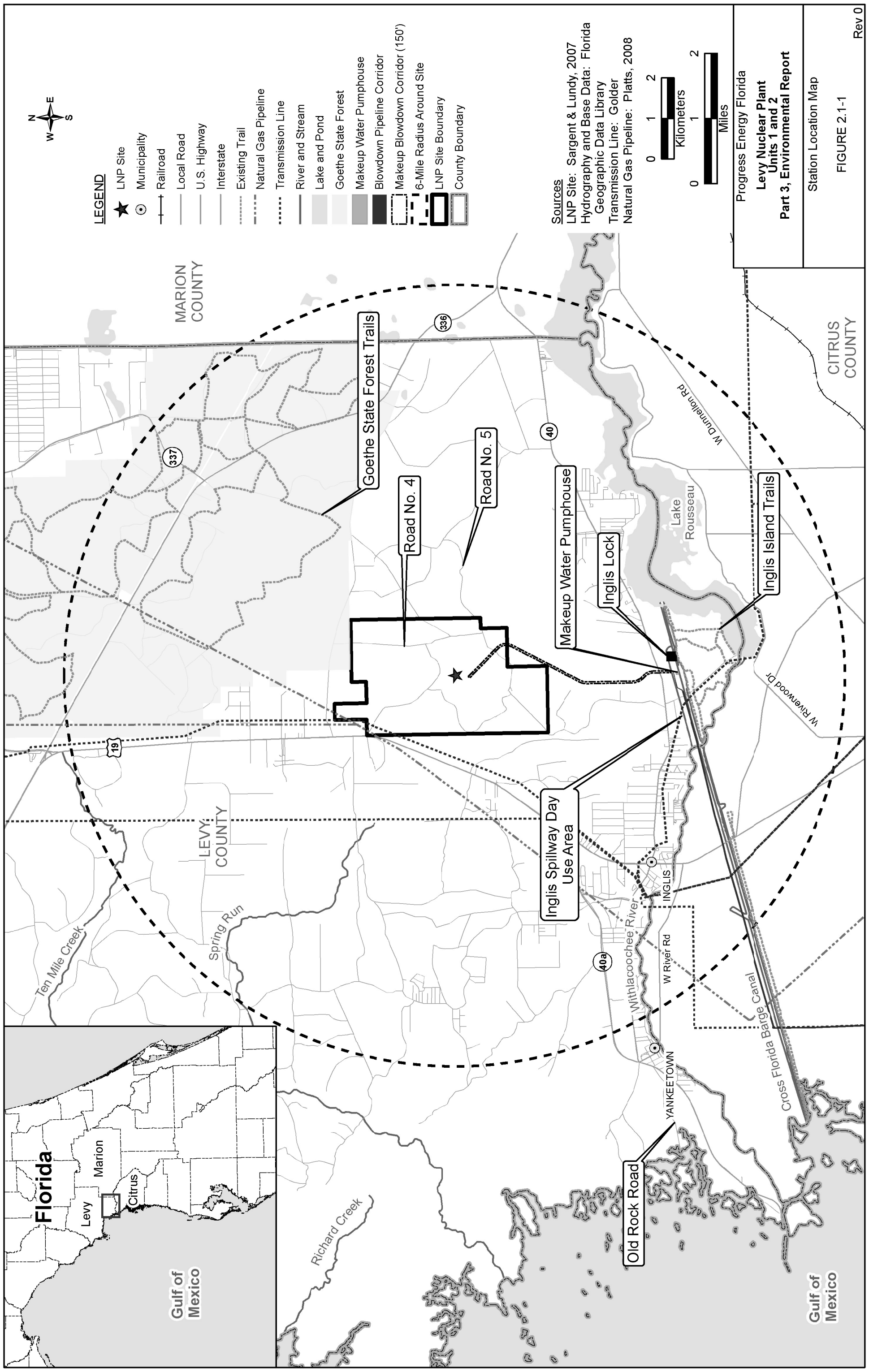


Figure 2-2. LNP Site and Vicinity (PEF 2009a)

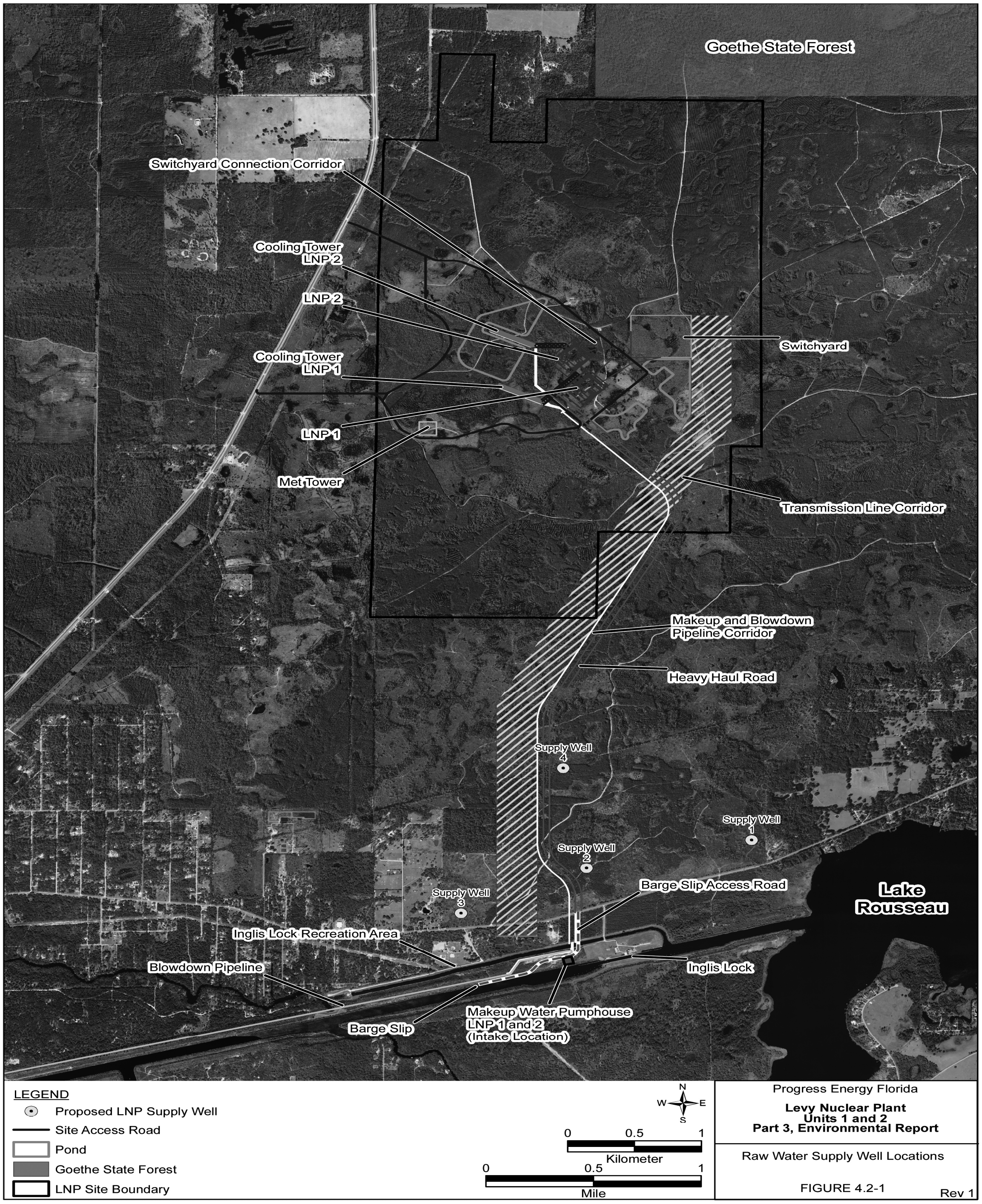


Figure 2-3. LNP Site and Select Offsite Facilities (PEF 2009a)

2.2.1 The Site and Vicinity

The LNP site encompasses 3105 ac in an unincorporated area of Levy County, Florida, east of US-19 and approximately 4 mi north of the Levy-Citrus County border (PEF 2009a). The site is located in a primarily rural area southwest of Gainesville and west of Ocala, about 9.6 mi northeast of the CREC. The LNP site, including the planned footprint for proposed LNP Units 1 and 2 and associated support buildings, encompasses an area of approximately 627 ac in the center of the site, as shown in Figure 2-3.

The LNP site is relatively level with very little variation in surface topography, no rivers, no streams, and no other major drainage features onsite (PEF 2009a). The site is partially located within a 100-year floodplain. Much of the site, especially the planned reactor location, has been in intensive forest plantation (pine tree production and harvesting operations) for over a century (PEF 2009a). The natural vegetation and configuration of the land surface have been significantly altered by these operations, resulting in a series of elevated hillocks (pine tree planting beds) separated by shallow furrows.

Pine plantations (represented onsite by coniferous plantations and wet planted pine plantation) encompass about 57 percent of the total land use within the site boundaries, cypress swamp covers almost 13 percent, and mixed wetland hardwoods cover about 10 percent (PEF 2009a, b). Details about these and other cover types present on the LNP site are provided in Section 2.4.1.1. Limited transportation, communications, and utilities land uses are present within the site boundary. No residential, commercial, or industrial services, strip mines, quarries, or gravel pits are located within the site. Land-use classifications within the LNP site and vicinity are shown in Figure 2-4.

A common corridor would extend south from the LNP site boundary to the CFBC, continuing west along the CFBC then south to the CREC. The common corridor would encompass some offsite facilities and transmission lines. The offsite facilities include the cooling-water intake pipelines, heavy-haul road, cooling-water intake structure (CWIS), barge slip, barge-unloading facility, water-supply wells, and associated supply well pipelines. The transmission-line corridors are described in Section 2.2.2.

As required by Section 307(c)(3)(A) of the Coastal Zone Management Act (16 USC 1456(c)(3)(A)), PEF consulted with the Florida State Clearinghouse to determine whether the proposed project is consistent with the Florida Coastal Management Program. PEF requested a coastal zone consistency determination on June 2, 2008, when its Site Certification Application was filed. On August 11, 2009, the Florida Siting Board unanimously approved the project. This decision constitutes the State’s certification of coastal zone consistency (FDEP 2009j).

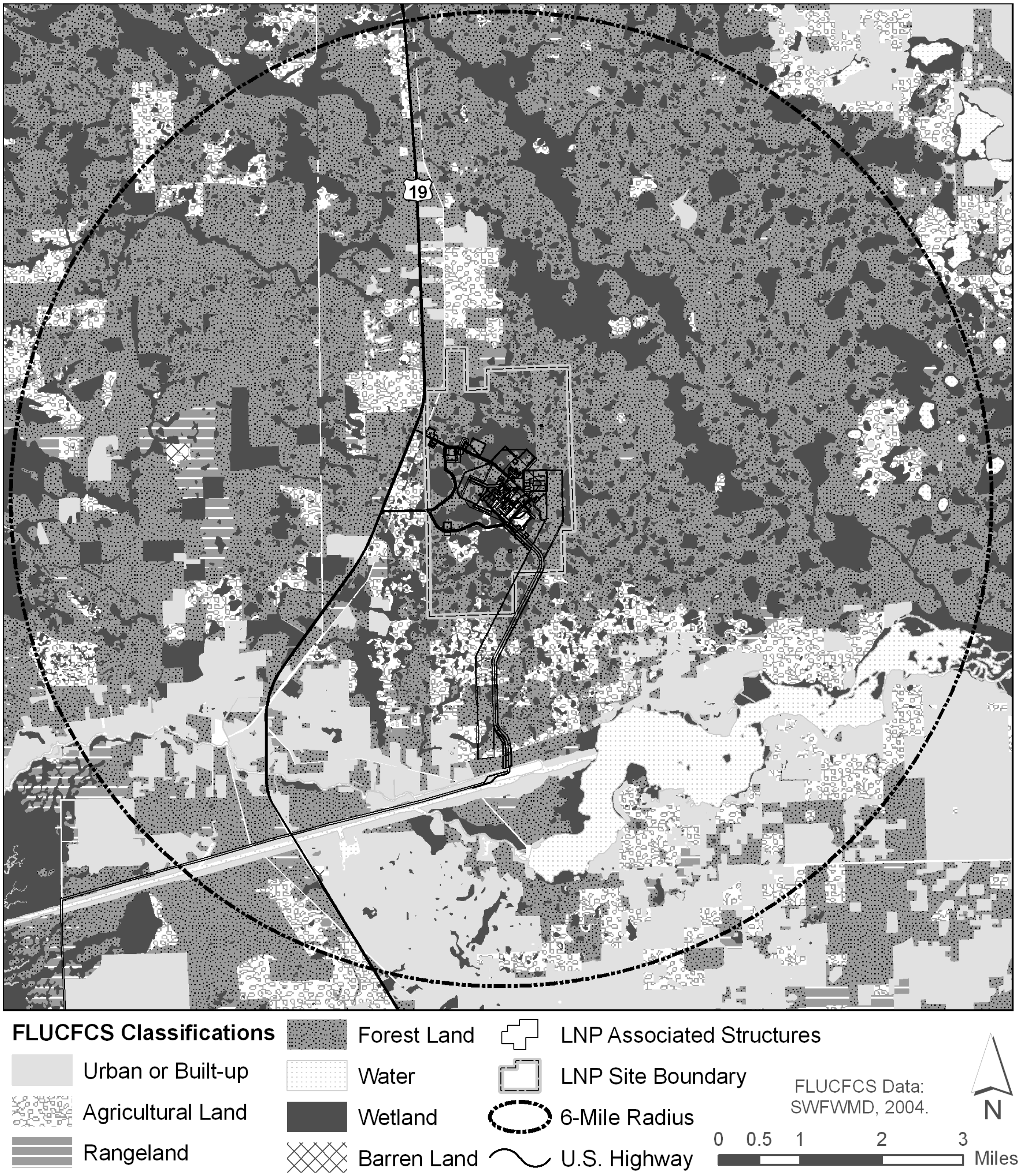


Figure 2-4. Principal Land Uses in the Vicinity of the LNP Site (SWFWMD 2004)

The remainder of this section describes the vicinity within the 6-mi radius of the LNP site (Figure 2-2). The nearest incorporated municipality is the town of Inglis, located approximately 4 mi from the nearest boundary of the LNP site. While there are small communities and clusters of homes in the vicinity, the area is sparsely populated. Lake Rousseau lies about 3 mi to the south. Lake Rousseau is an impoundment of the Withlacoochee River located at the intersection of Levy, Citrus, and Marion Counties. The reservoir has a surface area of 3700 ac (PEF 2008a).

The two new LNP units would draw makeup cooling water from the CFBC, an incomplete cross-Florida waterway, located approximately 4 mi south of the location of the proposed reactor units. The CFBC was a Federal project, however most of its lands (including those in the LNP vicinity) have been ceded to the State of Florida and incorporated into the Marjorie Harris Carr Cross-Florida Greenway and Conservation Area. The western portion of the CFBC is a dredged canal that extends from the Inglis Lock at Lake Rousseau to the Gulf of Mexico. These and other features within the 6-mi radius of the LNP site are shown in Figure 2-2.

The topography in the vicinity of the LNP site is flat, with the highest point being the highway overpass spanning the CFBC. From this vantage point, the two natural draft cooling towers of the nearby CREC can be seen above the tree tops. The vicinity of the LNP site north of the Withlacoochee River is primarily rural undeveloped land with a few homes and small farms.

About 68 percent of the LNP site vicinity is made up of deciduous forest lands, mixed forest lands, evergreen forest lands, and forested wetlands. About 8.6 percent of the land in the vicinity is devoted to residential land use. Croplands and pastures encompass 4.1 percent of the vicinity, and other agricultural lands encompass 3.9 percent (PEF 2009a). A 1500-ac private hunting ranch is located near the western border of the site. The 53,398-ac Goethe State Forest, which is adjacent to the LNP site to the northeast, is managed by the Florida Department of Agriculture and Consumer Services (PEF 2009a) (see Figure 2-2). The closest commercial land uses are the Food Ranch Supermarket, another small grocery store, and two convenience stores/gas stations, all located in Inglis. Transportation routes in the vicinity of the LNP site are limited to State and county roads (Figure 2-2). US-19 is a four-lane divided highway that connects Chiefland to Crystal River west of the LNP site. County Road 40 (CR-40) is a two-lane rural collector road that connects Citrus Springs to Inglis at US-19 south of the LNP site. No egress limitations are anticipated from the area surrounding the site based on the current levels of service (LOSs) designations of these highways (PEF 2009a).

Abandoned railroad tracks with only the railroad bed remaining are located along the northeastern portion of the site and north of State Route 336 (SR-336). No airports or active railroads are located within the site vicinity. Two pipelines for liquefied natural gas in the vicinity are owned and operated by Florida Gas Transmission Company. These underground pipelines are located on the north side of US-19 alongside the abandoned railroad track (PEF 2009a).

The State of Florida has State, regional, and local planning authorities. Each of the three counties located within the LNP site and vicinity has a comprehensive land-use plan; Levy County Comprehensive Plan (Levy County 2008c), Citrus County Comprehensive Plan (Citrus County 2008), and Marion County Comprehensive Plan (Marion County 2008). In February 2007, Levy County submitted an amendment to the Florida Department of Community Affairs (FDCA) to change the LNP site designation to "public use" to allow for a nuclear power-generating facility and to change the definition of "public use" in Levy County's 1999 Comprehensive Plan to include public utilities. FDCA approved the amendment. The Citrus County Comprehensive Plan includes utilities as a potential future land use within the vicinity of the LNP site. The Marion County Comprehensive Plan also identifies public utilities as a future land-use element. On September 23, 2008, the Florida Department of Environmental Protection (FDEP) received a determination from Levy County that PEF's LNP siting application is consistent with the county's existing local land-use plans and zoning ordinances (Florida Administrative Weekly 2008).

No portion of the LNP site or vicinity constitutes prime farmland as defined by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service at Title 7 Code of Federal Regulations (CFR) 657.5(a). There are several active mining or quarrying activities within the LNP vicinity, an inactive mine within the vicinity, and the Tarmac King Road Limestone Mine is being planned by Tarmac America, LLC (Tarmac), as discussed in more detail in Chapter 7 (PEF 2009a).

2.2.2 Transmission-Line Corridors

No existing transmission lines support the LNP site. Four new 500-kV transmission lines and two new substations are proposed. Two of the four lines would connect to the proposed Citrus substation, one would connect to the proposed Central Florida South substation, and one would connect to the CREC 500-kV switchyard. Approximately 82 mi of transmission-line corridors would be needed to make these connections (PEF 2009a). The transmission-line corridors would use PEF's existing high-voltage transmission-line corridors and other existing linear corridors and major roads to the maximum extent practicable. Additional 230-kV transmission lines from the new substations would be constructed to distribute power. These lines would require about 98 mi of new or widened corridors (PEF 2009k). The locations of the proposed transmission-line corridors are shown in Figure 2-5.

The Environmental Report (ER) (PEF 2009a) states that the proposed Citrus 1 and 2 500-kV transmission-line corridor would run south from the LNP site to the proposed Citrus substation in Citrus County, approximately 9 mi south of the LNP site. The proposed Crystal River 500-kV transmission line would run a total distance of 14 mi, first going south of the LNP site to the existing PEF 500-kV/230-kV transmission line, and then turning west and connecting to the CREC 500-kV switchyard in Citrus County. The proposed Sumter corridor would traverse approximately 59 mi, starting from the southern boundary of the LNP site, running east-

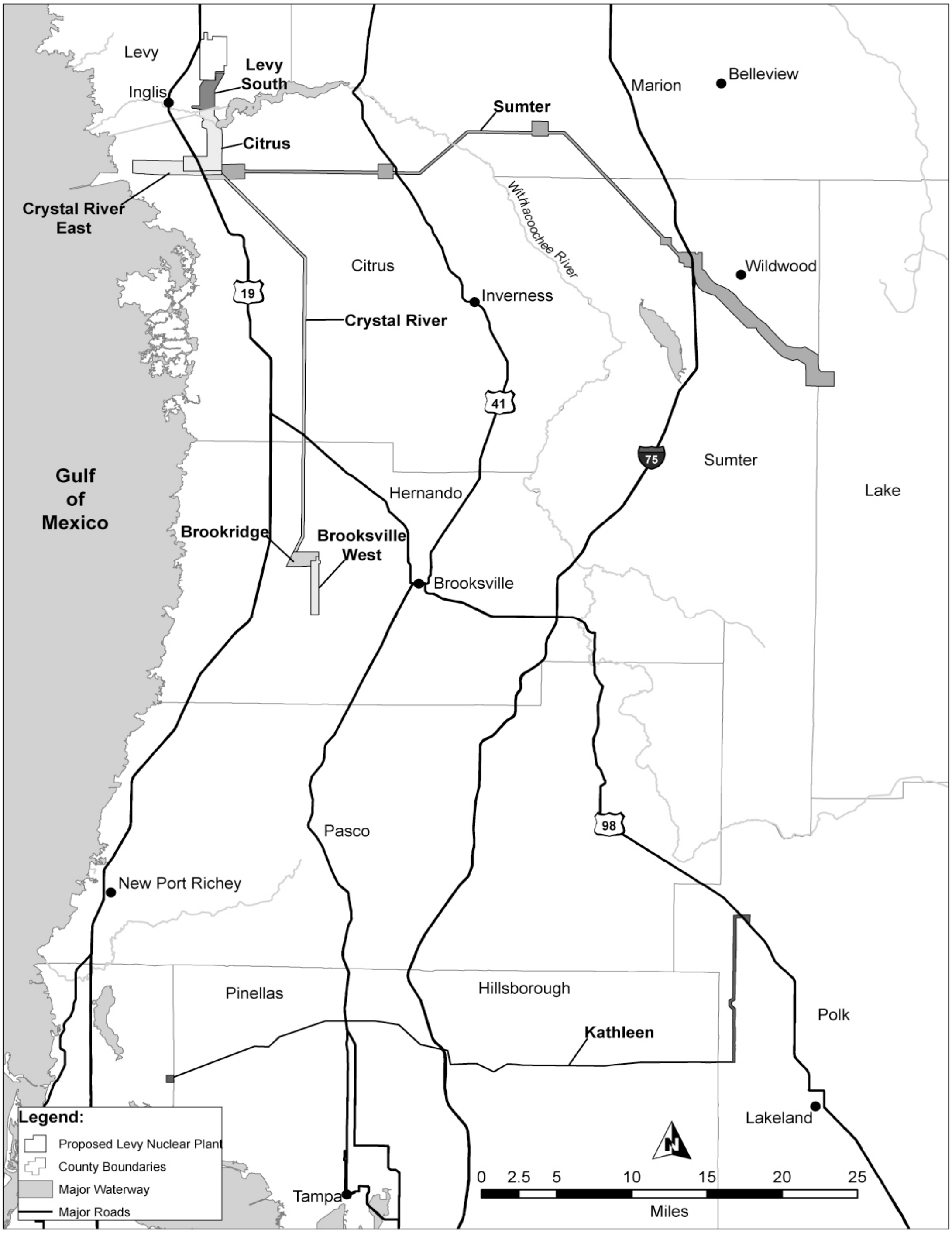


Figure 2-5. Locations of the Proposed Transmission-Line Corridors and Substations for the LNP Site (PEF 2009d)

southeast from the existing Crystal River East substation, and terminating at the proposed Central Florida South substation between the boundaries of Sumter and Lake Counties.

In addition, several new transmission lines would be required beyond the first substation to integrate power from the proposed LNP into the Florida electrical grid. These lines would include four 230-kV lines and one 500-kV line. Two of the 230-kV lines would run from the proposed Citrus substation to the Crystal River East substation (both in Citrus County); one would run approximately 38 mi south from the CREC 500-kV switchyard in Citrus County to the existing Brookridge substation in Hernando County, and one would originate at the existing Kathleen substation in Polk County and run south to the existing Griffin substation in Hillsborough County and then west, terminating at the existing Lake Tarpon substation in Pinellas County. The 500-kV transmission line would run from the Brookridge substation to the Brooksville West substation (both in Hernando County) (PEF 2009a). In addition, two 69-kV transmission lines would be required to support construction, both connecting to existing lines and entering the LNP site from the western and southern borders. These lines would require about 4.6 mi of new corridor (PEF 2009k).

PEF described the land use and land cover of the eight conceptual corridors amounting to 31,974 ac of land considered in planning the development of the transmission system to connect the proposed LNP to the grid (see Table 2-1). Because the exact routing of the transmission lines has not been determined as of publication of this draft EIS, the conceptual corridors overstate the acreage of land-use impacts that are discussed in Section 4.1.2.

2.2.3 The Region

The 50-mi region surrounding the LNP site is shown in Figure 2-1, including Bronson, the County Seat of Levy County, and the Levy County communities of Inglis, Yankeetown, Lebanon, Tidewater, Otter Creek, Williston, Chiefland, and Fanning Springs. The Gulf of Mexico is located about 7.9 mi west of the LNP site. The interstate highway closest to the LNP site is Interstate 75 (I-75), which is located approximately 28 mi to the east. Principal highways, rivers, hiking trails, State forest land, and recreation areas near the LNP site are shown in Figure 2-1 and Figure 2-2. There are no Federally recognized Indian Tribal lands within the region.

All or portions of the following 11 counties are within 50 mi of the LNP site: Levy, Citrus, Marion, Alachua, Dixie, Gilchrist, Hernando, Lake, Pasco, Putnam, and Sumter. The areas of land use within these 11 counties are listed in Table 2-2.

Table 2-1. Potentially Affected Land Uses and Habitats in Conceptual Transmission-Line Corridors Associated with the LNP Site in Acres.

FLUCFCS[a]	Land Use/Habitat	Citrus	Crystal River	Sumter	Levy North/ South	Brook-ridge	Brooks-ville West	Crystal River East	Kathleen	Total Acres	Percent of Acreage
110	Residential, Low Density	242.3	655.7	1023.2	123.5	486.0	490.0	0.0	400.7	3421.4	10.7
120	Residential, Medium Density	0.0	135.4	8.9	9.4	186.3	30.7	0.0	201.6	572.2	1.8
130	Residential, High Density	0.0	13.2	46.9	0.0	16.9	23.1	0.0	80.5	180.5	0.6
140	Commercial and Services	0.0	6.0	182.4	7.9	176.6	101.6	0.0	8.4	482.9	1.5
150	Industrial	0.0	0.0	53.7	0.0	3.9	0.0	3.7	33.6	94.8	0.3
160	Extractive	177.5	8.9	0.0	0.0	0.0	18.9	0.0	12.1	217.4	0.7
170	Institutional	10.2	0.5	9.8	0.0	25.7	2.3	0.0	7.0	55.3	0.2
180	Recreational	15.3	11.1	40.8	21.2	33.2	0.4	0.0	10.4	132.5	0.4
182	Golf Courses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.4	25.4	0.1
190	Open Land	865.4	589.8	874.6	1.0	293.9	67.0	2.2	72.4	2766.1	8.7
210	Cropland and Pastureland	598.7	63.4	5218.8	0.0	0.0	29.5	1.1	643.4	6554.9	20.5
214	Row Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	17.0	0.1
220	Tree Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.2	71.2	0.2
230	Feeding Operations	0.0	0.0	0.0	0.0	0.0	9.2	0.0	3.9	13.1	0.0
240	Nurseries and Vineyards	0.0	0.0	2.9	0.0	0.0	5.4	0.0	11.4	19.7	0.1
250	Specialty Farms	0.0	0.0	19.0	0.0	0.0	0.0	0.0	7.4	26.4	0.1
260	Other Open Lands (Rural)	0.0	17.9	322.8	150.9	8.1	24.8	0.0	83.2	607.6	1.9
310	Herbaceous	0.0	0.0	0.3	0.0	4.9	0.0	0.0	0.0	5.1	0.0
320	Shrub and Brushland	32.5	59.3	143.5	2.0	19.5	0.0	10.0	83.5	350.4	1.1
330	Mixed Rangeland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	0.0
410	Upland Coniferous Forests	101.5	977.8	1000.9	78.2	1189.1	170.0	13.9	0.0	3531.4	11.0
411	Pine Flatwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.7	59.7	0.2
420	Upland Hardwood Forests	0.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	60.0	0.2
430	Upland Hardwood Forests - Continued	676.1	95.5	1362.8	108.7	3.8	0.0	341.1	0.0	2588.0	8.1
434	Hardwood-Conifer Mixed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	231.3	231.3	0.7
440	Tree Plantations	387.7	147.1	333.1	702.8	0.0	13.9	839.6	17.2	2441.5	7.6
510	Streams and Waterways	62.1	0.0	4.3	0.0	0.0	0.0	0.0	3.9	70.3	0.2

Table 2-1. (contd)

FLUCFCS[(a)]	Land Use/Habitat	Citrus	Crystal River	Sumter	Levy North/ South	Brook-ridge	Brooks-ville West	Crystal River East	Kathleen	Total Acres	Percent of Acreage
520	Lakes	10.6	2.9	61.5	0.0	104.6	0.0	0.0	7.5	187.1	0.6
530	Reservoirs	4.5	1.1	37.9	0.6	1.1	0.0	29.0	56.0	130.1	0.4
540	Bays and Estuaries	0.2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.0	0.0
610	Wetland Hardwood Forests	54.4	7.6	632.7	0.0	0.0	0.0	18.9	0.0	713.5	2.2
615	Steams and Lake Swamps (Bottomland)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.7	100.7	0.3
620	Wetland Coniferous Forests	17.7	8.5	13.7	141.9	0.0	0.0	3.3	5.8	190.8	0.6
621	Cypress	0.0	0.0	0.0	0.0	0.0	0.0	0.0	107.6	107.6	0.3
630	Wetland Forested Mixed	104.0	0.0	27.2	76.9	0.0	0.0	199.5	93.6	501.1	1.6
640	Vegetated Nonforested Wetlands	136.0	36.8	685.4	50.7	89.7	0.0	144.8	0.0	1143.5	3.6
641	Freshwater marshes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	187.7	187.7	0.6
643	Wet Prairies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	15.7	0.0
644	Emergent Aquatic Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	6.2	0.0
650	Nonvegetated	0.0	4.7	15.7	0.0	5.7	7.2	8.0	0.0	41.3	0.1
653	Intermittent Ponds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0
740	Disturbed Lands	0.0	22.8	98.5	0.0	8.1	7.8	5.3	0.7	143.2	0.4
810	Transportation	34.6	15.9	506.9	0.0	55.8	12.0	5.9	16.8	647.8	2.0
830	Utilities	24.2	642.6	1230.7	9.5	120.7	198.0	787.2	241.4	3254.3	10.2
	Linear Run (mi)[1]	9	14	59	4.6	38	3	0.8	50	178 mi	
	Total Acreage	3555.1	3524.5	14,018.7	1485.3	2833.6	1211.6	2414.2	2931.4	31,974.3	100.0
	Percent	11.1	11.0	43.8	4.6	8.9	3.8	7.6	9.2	100.0	

Sources: PEF 2009b, d

(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System (FDEP 2010a).

Table 2-2. Land Use in the Region

Land Use	Area (ha)	Area (ac)	Percent of Region
Bays and estuaries	185,687	458,826	12.1
Beaches	9	22	0.0
Commercial and services	10,348	25,570	0.7
Confined feeding operations	558	1379	0.0
Cropland and pasture	266,701	659,009	17.4
Deciduous forest land	135,465	334,729	8.8
Dry salt flats	232	573	0.0
Evergreen forest land	789	1950	0.1
Forested wetland	137,556	339,896	9.0
Herbaceous rangeland	3641	8997	0.2
Industrial	3556	8787	0.2
Lakes	25,358	62,659	1.7
Mixed forest land	118,562	292,963	7.7
Mixed rangeland	16,165	39,943	1.0
Mixed urban or built-up	5570	13,763	0.4
Nonforested wetland	226,818	560,460	14.8
Orchards, groves, vineyards, nurseries, and ornamental horticultural areas	38,524	95,191	2.5
Other agricultural land	123,605	305,424	8.0
Other urban or built-up land	127	314	0.0
Reservoirs	3543	8755	0.2
Residential	189,352	467,882	12.3
Sandy areas other than beaches	2	5	0.0
Shrub and brush rangeland	10,733	26,521	0.7
Streams and canals	3355	8290	0.2
Strip mines, quarries, and gravel pits	10,412	25,728	0.7
Transitional areas	5210	12,874	0.3
Transportation, communications, and utilities	14,734	36,407	1.0
Total	1,536,612	3,796,916	100.0

Source: PEF 2009a

Within the region, approximately 17.4 percent of the land is cropland and pasture, 14.8 percent is nonforested wetland, 12.3 percent is residential, 12.1 percent is bays and estuaries, 9.0 percent is forested wetland, 8.8 percent is deciduous forest land, 8.0 percent is other agricultural land, and 7.7 percent is mixed forest land (PEF 2009a). There are a number of limestone mines and aggregate quarries within the region (e.g., Holcim Mine, Inglis Quarry, Crystal River Quarries, and Gulf Hammock Quarry).

2.3 Water

This section describes the hydrologic processes and waterbodies in and around the LNP site, the existing water use, and the quality of water in the environment of the proposed LNP Units 1 and 2. This description is limited to only the parts of the hydrosphere that may affect or be affected by building and operation of proposed LNP Units 1 and 2. During operations of proposed LNP Units 1 and 2, the Gulf of Mexico, via the CFBC would be the source of makeup water for normal plant operations (Figure 2-6). The blowdown from LNP Units 1 and 2 cooling towers and other treated wastes would be discharged through a new discharge pipeline routed from the LNP into the existing CREC discharge canal and eventually to the Gulf of Mexico. The CREC consists of five power plants. CREC Unit 3 is a nuclear power plant while the other four are fossil units. The circulating-water systems of the five units use the CREC discharge canal to return cooling water to the Gulf of Mexico. Therefore, the environment described in this section includes the following:

- the Gulf of Mexico, because it is the source of makeup water for normal plant operations and it would receive the effluents discharged from the plant
- the CFBC downstream of the Inglis Lock because its water quality may be affected by water pulled from the Gulf of Mexico by LNP Units 1 and 2
- the Old Withlacoochee River (OWR, a remnant arm of the Withlacoochee River) below the Inglis Dam because its water quality may be affected by water pulled from the Gulf of Mexico by LNP Units 1 and 2
- the Waccasassa River, the Withlacoochee River, Spring Run, and Direct Runoff to Gulf of Mexico sub-basins because portions of the LNP sites lie in the last three and because the last two are located within the first
- Lake Rousseau, including the Inglis Dam and Inglis Lock bypass channel and spillway because they control the flow of the Withlacoochee River downstream of the Inglis Dam and around the Inglis Lock
- the LNP discharge pipeline and the CREC discharge canal because the former would convey effluents from the LNP site to the latter for discharge to the Gulf of Mexico
- local surface-water features (lower Withlacoochee River and CFBC) adjacent to the site that may receive stormwater runoff
- the local and regional groundwater systems, because they are a source of water during building and operation of LNP Units 1 and 2.

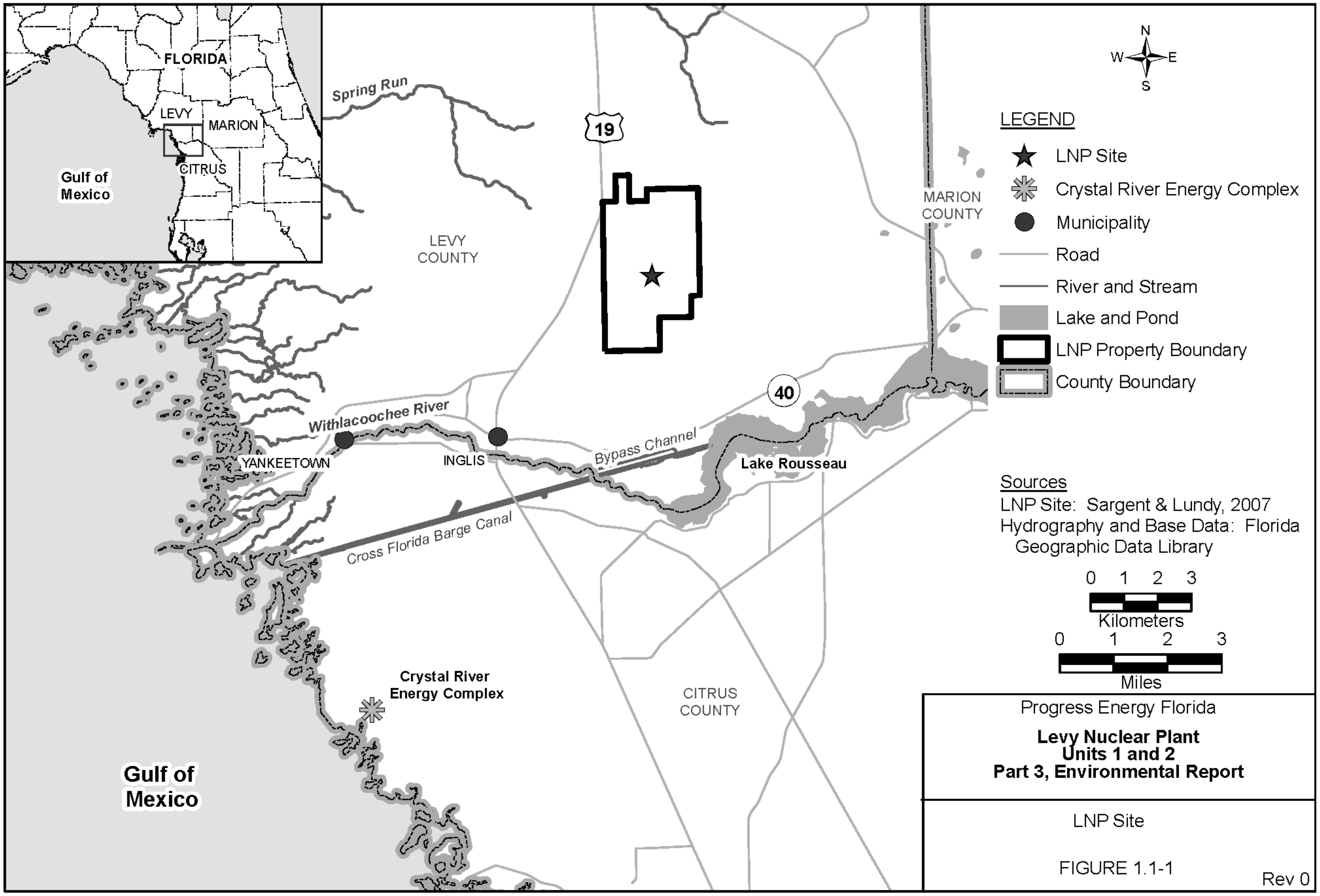


Figure 2-6. Gulf of Mexico as the Source of Makeup Water for the Proposed LNP (PEF 2009a)

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could be affected by building and operation of proposed LNP Units 1 and 2. The hydrologic conditions at the LNP site are described in Section 2.4 of the Final Safety Analysis Report (FSAR) (PEF 2009k). A summary of the hydrologic conditions of the LNP site is provided in Section 2.3 of the ER (PEF 2009a). The following descriptions are based on information from the FSAR (PEF 2009k), the ER (PEF 2009a), and the following sources of publicly available hydrological data: FDEP 2001; FDEP 2006; FDEP 2009b, c, d, e, f, g, h, i, j, k; NOAA 2009a, b.

On a longer-term scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge by the U.S. Global Change Research Program (GCRP), a Federal Advisory Committee, has been considered in preparation of this EIS. According to the GCRP, it is reasonably foreseeable that sea-level rise may exceed 3 ft by the end of the century (GCRP 2009). At a location, relative sea-level rise can have two components: (1) eustatic rise caused by absolute change in water volume of the oceans and (2) apparent rise in sea level caused by land subsidence. The increase in sea level would result in the saltwater front in the CFBC moving further inland.

2.3.1.1 Surface-Water Hydrology

Figure 2-7 shows the location of the LNP site with respect to the Withlacoochee and the Waccasassa river basins. Most of the LNP site lies in the Spring Run and Direct Runoff to Gulf of Mexico sub-basins of the Waccasassa River basin; a small southern portion of the site lies in the Withlacoochee River basin (Figure 2-8). Neither the Spring Run nor the Direct Runoff to Gulf of Mexico sub-basins of the Waccasassa River basin contributes runoff to the Waccasassa River. The drainage area of the Waccasassa River basin is approximately 936 mi^2 with an annual mean discharge of 293 cfs (FDEP 2001).

There are two rivers named Withlacoochee in Florida. The northern Withlacoochee River originates near Tifton in southern Georgia and flows south to meet with the Suwannee River in Florida near Ellaville. The confluence of the northern Withlacoochee River with the Suwannee River at Ellaville is approximately 100 mi north-northwest of the LNP site. The southern Withlacoochee River originates in Green Swamp near Dade City, Florida and flows north and west through eight counties before discharging into the Gulf of Mexico near Yankeetown, Florida. The southern Withlacoochee River basin is approximately 2100 mi^2 in size and may be divided into three portions: the upper portion that extends from its headwaters in the Green Swamp to its confluence with the Little Withlacoochee River, the middle portion that lies between its confluence with the Little Withlacoochee River to US-41 just upstream of Lake Rousseau, and the lower portion that includes Lake Rousseau, the CFBC, and its lowest reach to the Gulf of Mexico. The Withlacoochee River has an annual mean discharge of 970 cfs

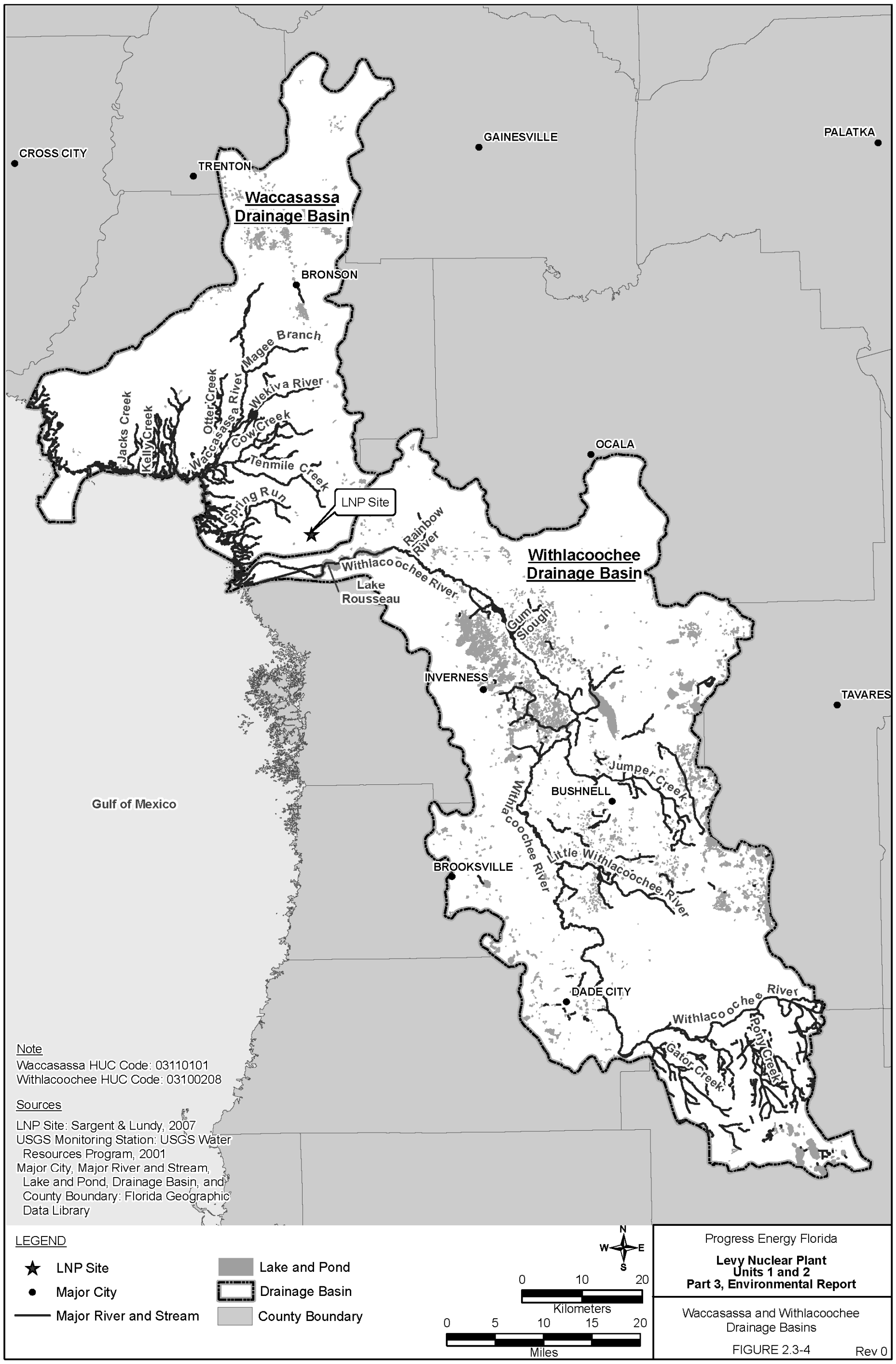


Figure 2-7. Location of the LNP Site with Respect to the Adjacent Watersheds and River Basins (PEF 2009a)

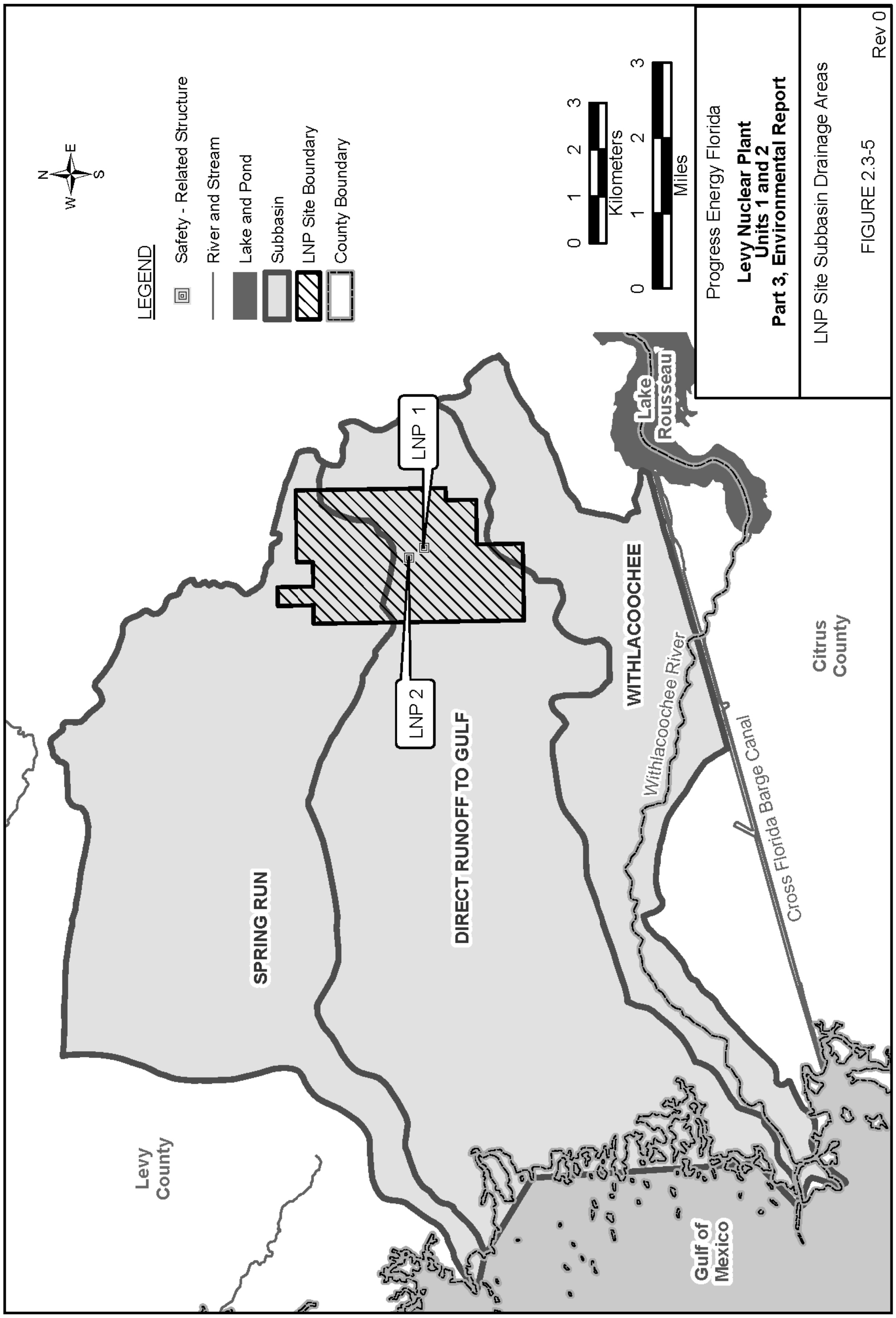


Figure 2-8. Location of the LNP Site with Respect to Sub-Basin Drainage Areas (PEF 2009a)

above Lake Rousseau near Holder, Florida. The drainage area of the Withlacoochee River basin at this location is 1825 mi^2.

Lake Rousseau, approximately 5.7 mi long, is formed by the Inglis Dam on the Withlacoochee River near the town of Inglis. The water-surface elevation in the lake is controlled by the Inglis Dam, the Inglis Lock, and the Inglis Lock bypass channel and spillway. Most of the normal flow of the river leaves Lake Rousseau entering a bypass channel that parallels the CFBC on the north. The water eventually goes over a spillway and enters the lower portion of the Withlacoochee River approximately 1.5 mi downstream of Lake Rousseau. During floods, water may be discharged over a spillway located on the Inglis Dam into the OWR. The OWR flows downstream from the spillway to discharge into the CFBC approximately 1.7 mi downstream of the Inglis Lock. Due to the presence of the CFBC, the OWR is not connected to the lower Withlacoochee River (Figure 2-9).

The Canal Authority of Florida was created in 1933 to construct and maintain a deep-water shipping channel across the state (FDEP 2009a), linking the Gulf of Mexico near Inglis to the Atlantic Ocean near Jacksonville. Construction of the canal, now known as the CFBC, began under the Emergency Relief Appropriations Act of 1935 but was suspended in 1936 when the funds were exhausted. In 1942, the U.S. Congress authorized construction of the CFBC and the U.S. Army Corps of Engineers (USACE) started its construction in 1964. During subsequent decades, environmental concerns resulted in suspension of construction and eventual deauthorization of the project in 1990.

All waters in Florida belong to one of five categories, Class I through V, defined by Florida Administrative Code (FAC) 62-302.400 (FDEP 2009b). In addition, waters worthy of special protection because of their natural attributes may also be designated Outstanding Florida Waters (OFWs) as defined by FAC 62-302.700. The State of Florida designates waters in the national parks, preserves, memorials, wildlife refuges, wilderness areas, State Park System and Wilderness Areas, national forests, seashores, monuments, and marine sanctuaries, scenic rivers, and other waters within areas specified by State laws as OFWs. OFWs are generally described as worthy of special protection because of their natural attributes. FDEP is generally prohibited from issuing permits that would allow direct pollutant discharges to these waters or allow indirect discharges that would significantly degrade quality of these waters. The lower Withlacoochee River downstream from the Inglis Lock bypass channel and spillway down to the Gulf of Mexico is designated as an OFW. The CFBC between Inglis Lock and the Gulf of Mexico is not designated as an OFW; neither is the OWR.

The river basins that are relevant for the proposed LNP project are Suwannee, Withlacoochee, and Springs Coast (Figure 2-7). The FDEP adopted a revised list of impaired waters in the Suwannee and the Spring Coast river basins on May 19, 2009, and the draft verified list of

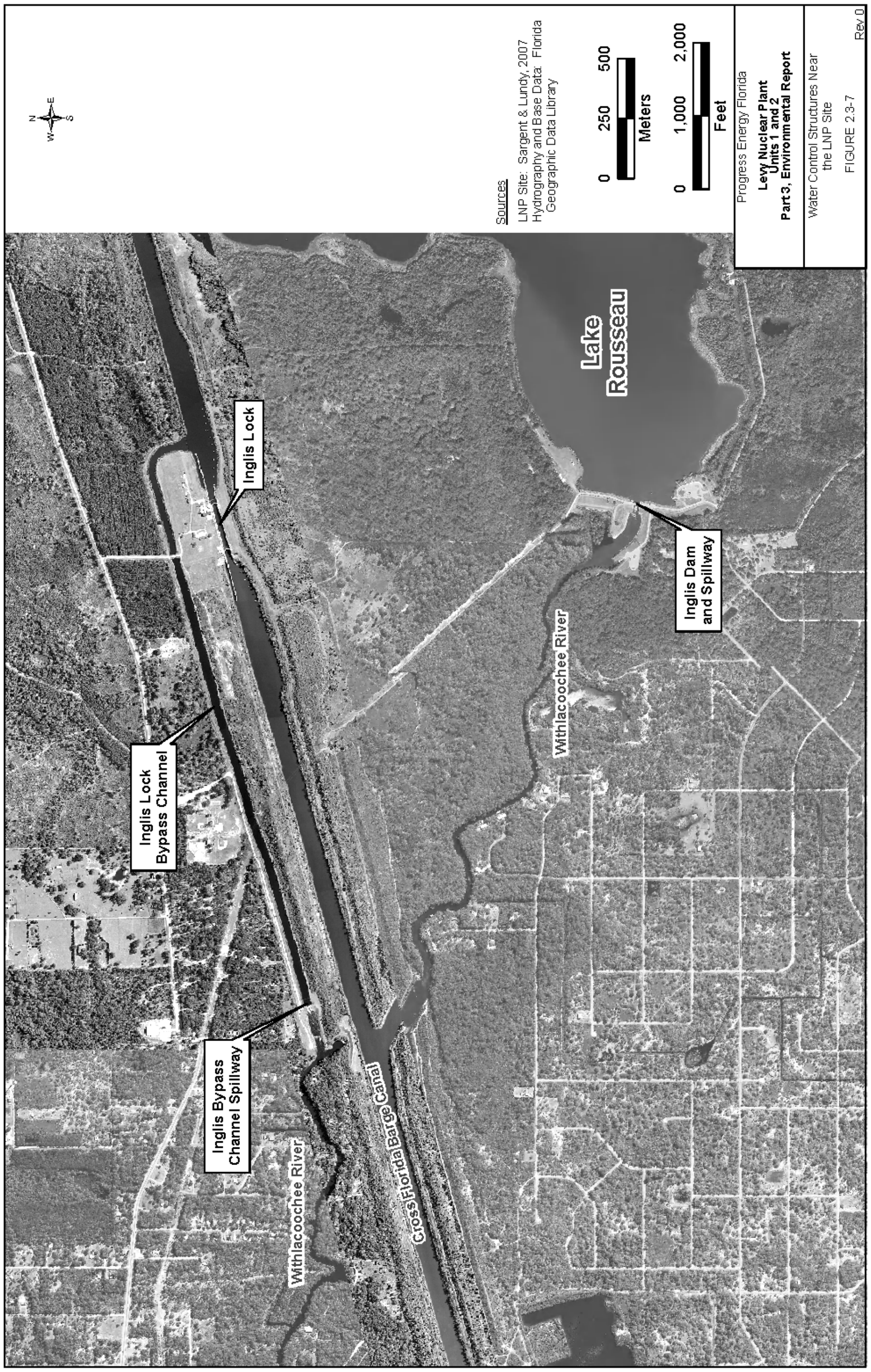


Figure 2-9. The Hydrologic Setting Near the Head of the Cross Florida Barge Canal, Including Water-Control Structures (PEF 2009a)

impaired waters for the Withlacoochee River basin was published on April 30, 2010 (FDEP 2009c). Several streams, estuaries, and coastal water segments are listed as impaired in the Waccasassa and Withlacoochee river planning units for coliforms, nutrients, mercury, bacteria, and dissolved oxygen (FDEP 2009d). In the upper Withlacoochee planning unit, Mud Lake is listed for nutrients (FDEP 2006). Coastal areas and estuaries on the Springs Coast are listed for nutrients, bacteria, and mercury (FDEP 2009e).

Historical climate summaries for daily weather stations in the southeast United States, including Florida, are available from the Southeast Regional Climate Center (SRCC 2010). The review team obtained monthly precipitation summaries for 13 stations near the LNP site. Mean monthly precipitation near the LNP site varies from 1.62 to 9.79 inches. Maximum mean monthly precipitation occurs in the months of July or August and the minimum mean monthly precipitation occurs in the months of October or November. Based on monthly precipitation data from the 13 stations, the review team determined that the mean annual precipitation in the region is approximately 53 inches.

The water-surface elevations in the Gulf of Mexico are subject to tidal fluctuation. The mouth of the CFBC in the Gulf of Mexico is located approximately 20 mi southeast of Cedar Key, Florida, where the National Oceanic and Atmospheric Administration (NOAA) maintains the nearest tide gauge. The mean tidal range (the difference between the mean high water and mean low water) at Cedar Key is 0.89 ft and the diurnal range (the difference between mean higher high water and mean lower low water) is 1.35 ft (NOAA 2009a). The long-term eustatic rise in eustatic sea level at Cedar Key, Florida, estimated from historical, 1914-to-2006 tide gauge data, is 0.59 ± 0.06 ft/century (NOAA 2009b). As stated above, land subsidence can affect the relative sea-level rise observed at a location. Land subsidence can be caused by excessive withdrawal of groundwater or other pressurizing substances like oil and gas. In areas where the subsurface material is predominantly inelastic clay, land subsidence may be a permanent effect because inelastic clays do not regain their original pressurized volume. Section 2.8 below describes the geology near the LNP site. The principal aquifer near the LNP site, the Floridan, is a thick sequence of carbonate rock, primarily limestones and dolomites of Tertiary Age. The Floridan aquifer is overlain by unconsolidated materials. The surface soils near the LNP site consist of undifferentiated sands. There are no faults or other geologic structures of concern in the vicinity of the LNP site, which is consistent with information presented in the USGS Ground Water Atlas (USGS 2000). The area near the LNP site is geologically stable. The proposed layout of the powerblock area of proposed LNP Units 1 and 2 is shown in Figure 2-10 and Figure 2-11. Most of the LNP site falls within the 100-year floodplain. There are no named streams on the site. Runoff generally drains to the southwest toward the lower Withlacoochee River and the Gulf of Mexico.

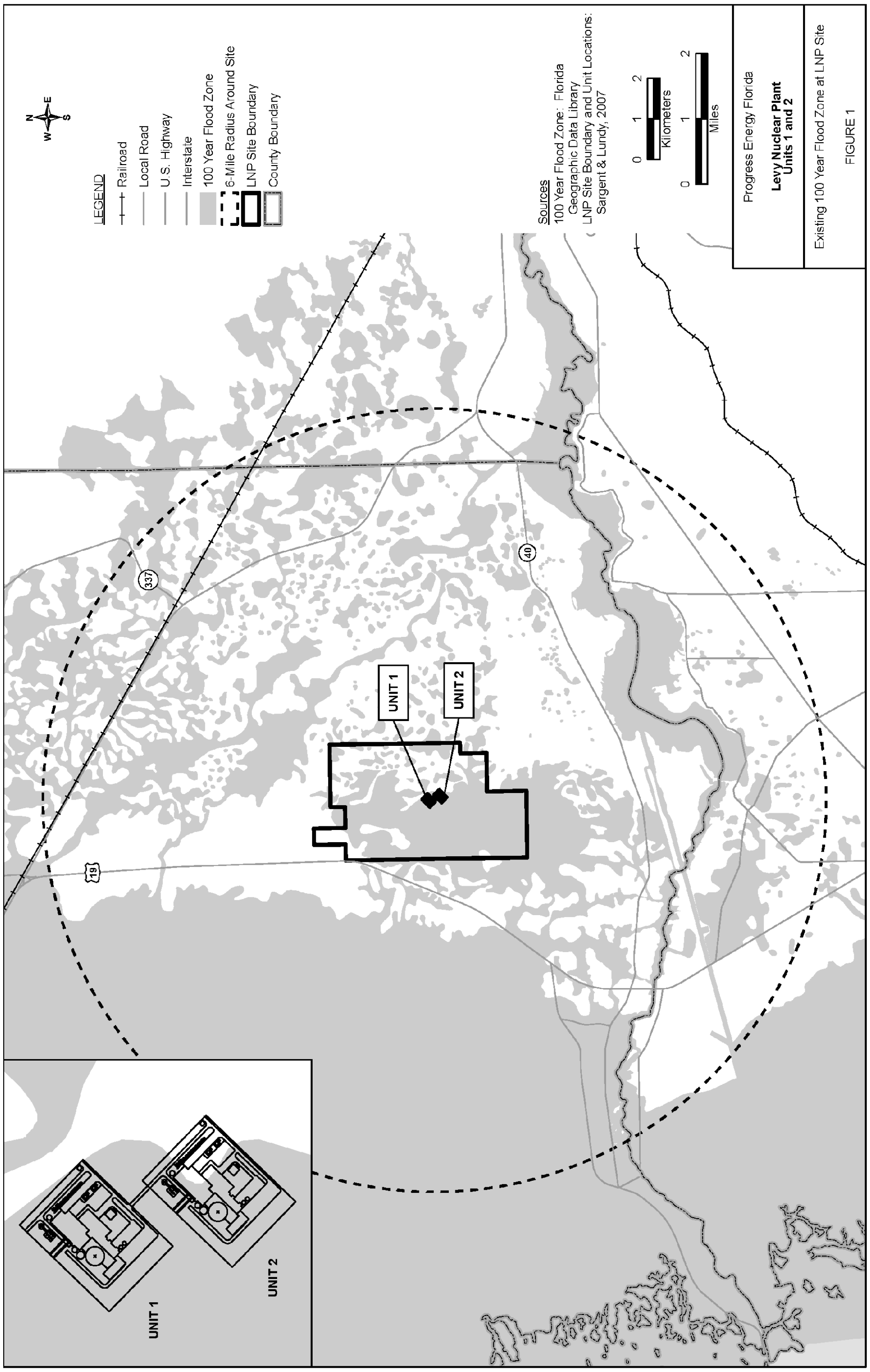


Figure 2-10. The Plant Site for Proposed LNP Units 1 and 2 (PEF 2009d)

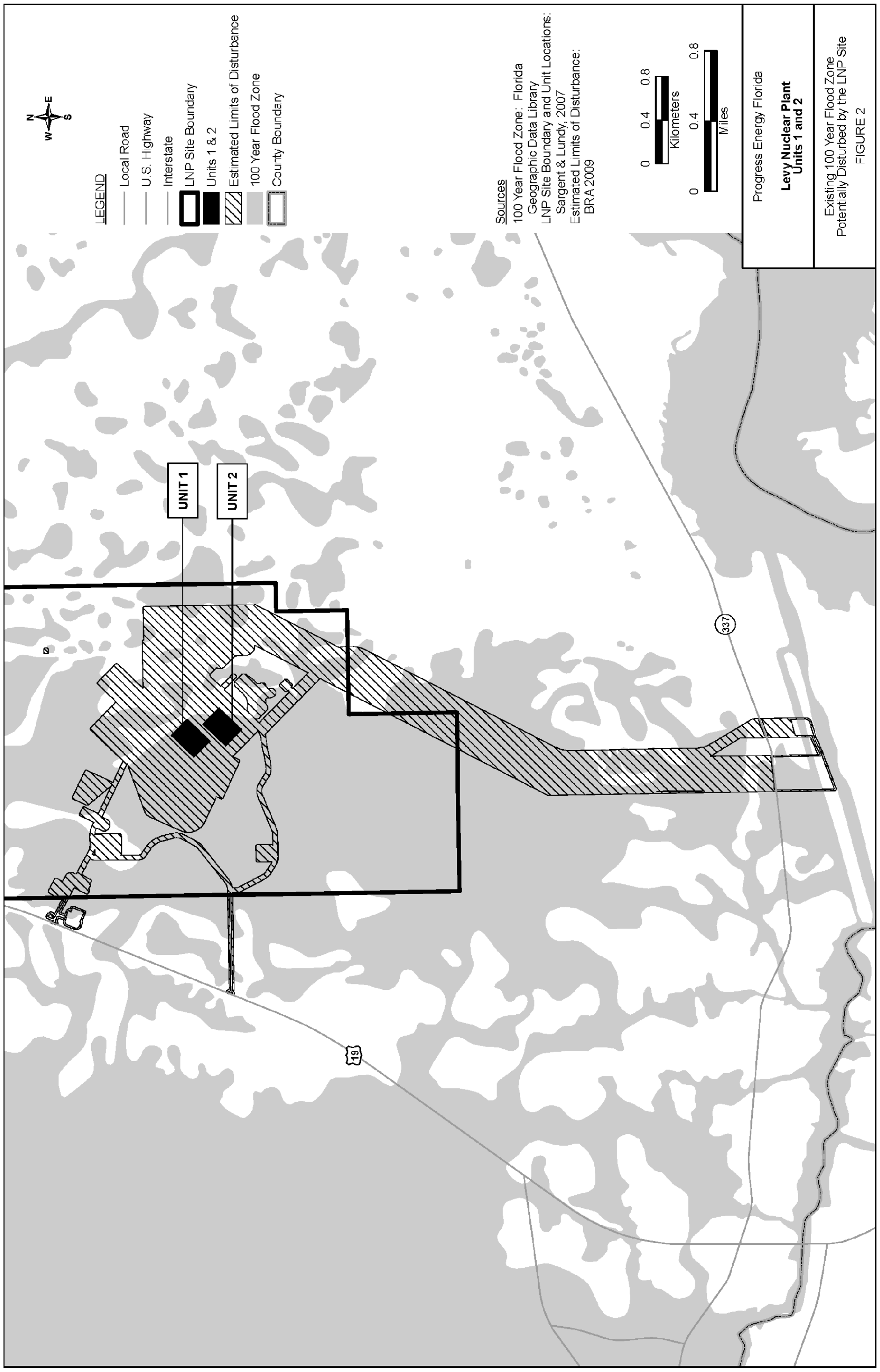


Figure 2-11. LNP Units 1 and 2 Footprint, the 100-Year Flood Plain, and the Estimated Area to be Disturbed During Construction (PEF 2009d)

2.3.1.2 Groundwater Hydrology

Groundwater aquifers in the region and the vicinity of the LNP site are described in Section 2.3 of the ER (PEF 2009a) and Section 2.4.12.1 of the FSAR (PEF 2009k). Geohydrologic descriptions provided in these documents are consistent with regional descriptions provided in Chapter 6 of the U.S. Geological Survey (USGS) Ground Water Atlas of the United States (USGS 2000) for the Floridan aquifer system. In this portion of west-central Florida, groundwater occurs in a surficial aquifer composed of unconsolidated sediments and an underlying carbonate rock aquifer known as the Floridan aquifer system. No confining unit exists between the surficial and Upper Floridan aquifer systems in this area and thus, the two aquifers are hydraulically connected. Neither of the aquifers is classified as a sole-source aquifer. The closest sole source aquifer is the Volusia Sole Source Aquifer, located approximately 80 mi east of the LNP site (EPA 2009).

The surficial aquifer system, which is less permeable than the Floridan aquifer system, is composed primarily of sands and provides substantial recharge to the Floridan aquifer. The principal use of the surficial aquifer is for irrigation and domestic use on a small scale. This aquifer is also subjected to dewatering associated with mining and/or construction activities. In parts of north and central Florida, the surficial aquifer system and Floridan aquifer system are hydraulically separated by the Hawthorn formation, a series of clastic marine sediments. At the LNP site, the surficial aquifer lies directly over the Floridan aquifer limestones of the Avon Park Formation. The Hawthorn Group and the Tampa, Suwannee, and Ocala limestones are not present at this location.

The Floridan aquifer system consists of both upper and lower Floridan aquifers. In the vicinity of the LNP site, the Upper Floridan aquifer is composed entirely of Avon Park limestones. This aquifer, which is the portion of the Floridan aquifer system that would potentially be affected by LNP operations, is the main source of potable water (both private and municipal) and spring flow in west-central Florida. The typical thickness of the Upper Floridan aquifer in the region near the LNP site, based on regional information for west-central Florida, is estimated to be 750 ft (PEF 2009d). The upper and lower Floridan aquifers are separated by a low-permeability carbonate rock sequence informally called the middle confining unit. This confining unit is made up of varying types of carbonate rocks, from very fine-grained limestones to limestone or dolomite with pore space infilled with anhydrite or quartz. The underlying Lower Floridan aquifer is less well characterized due to its greater depths and lower number of characterization boreholes available. In addition, saline conditions generally exist in these deeper intervals and thus they are not typically used as a potable water source.

A site investigation that included 118 geotechnical borings to characterize subsurface conditions at the proposed LNP Units 1 and 2 locations confirmed this generalized stratigraphy. The surficial aquifer, which was generally encountered at depths of less than 5 ft, varied in thickness from 10 to 200 ft, with an average thickness of approximately 50 ft. The surficial aquifer transitioned into the underlying marine carbonates of the Avon Park Formation gradually rather than at an abrupt bedding contact. To the maximum depth explored by this investigation (500 ft), neither the middle confining unit nor the Lower Floridan aquifer was encountered. However, traces of the evaporite deposits and quartz-infilled porosity typical of the middle confining unit were observed sporadically in the borings at depths below 400 ft. These borings may thus have approached the middle confining unit. On this basis, PEF estimates that the Upper Floridan aquifer is approximately 520 ft thick beneath the LNP site (PEF 2009d). Based on geophysical logging and measurement of drilling fluid losses during the advancement of borings, the most productive interval of this aquifer appears to be at depths from 100 to 300 ft below ground surface (bgs).

Karst is a terrain in which near-surface carbonate rocks have been partially dissolved by rainwater and groundwater, producing large solution openings that can readily transmit groundwater and where sinkholes can provide easy connections between the surface and groundwater (White 1988). Karst is a problem in many areas of Florida. However, few sinkholes occur near the LNP site (Randazzo and Jones 1997; Miller 1986) and the regional transmissivity of the Upper Floridan aquifer in the area is less than would be expected for well-developed karst (USGS 2000). Some of the wetlands onsite may reflect karst development (PEF 2009a). In most of southern Levy County, the vulnerability of the Floridan aquifer to contamination from the surface has been classified as “Vulnerable.” However, the proposed LNP is within 1 to 2 mi of areas classified as “Most Vulnerable” (Baker et al. 2007).

Hydraulic Properties

The Upper Floridan aquifer is very productive and serves as the primary source of spring flows and potable water for private and municipal supply in western Florida (PEF 2009a). Model-derived transmissivity distributions developed by the USGS (PEF 2009a) indicate that transmissivities for the Upper Floridan aquifer in west-central Florida generally range from 50,000 to 500,000 ft^2/d. PEF constructed a local-scale groundwater model as a requirement of the facility’s Site Certification Application to the State of Florida. This model, which was a submodel of the Southwest Florida Water Management District’s (SWFWMD’s) District-Wide Regulation Model, Version 2 (DWRM2) regional groundwater flow model, was used to simulate both LNP and cumulative groundwater-use impacts (PEF 2009e). Upper Floridan aquifer transmissivities specified for the model within the boundary of the LNP site ranged from 20,000 to 240,000 ft^2/d. Hydraulic conductivities for the surficial aquifer ranged from 15 to 20 ft/d.

Site-specific hydraulic properties for the surficial and Upper Floridan aquifers were characterized using both slug test and pumping test methods. ER Section 2.3.1.5.5 (PEF 2009a) describes slug tests that were performed in all 23 wells. Results from these tests were analyzed using the Bouwer and Rice (1976) method. Hydraulic conductivity estimates ranged from 0.9 to 28.6 ft/d in the surficial aquifer and from 2.4 to 54.4 ft/d in the Upper Floridan aquifer, with average reported values of 9.2 and 13.9 ft/d for the surficial and Upper Floridan aquifers, respectively. It should be noted that the average reported slug test values for both aquifers fall below the lower end of the hydraulic property range specified in the DWRM2 groundwater flow model, indicating that test conditions may result in nonrepresentative hydraulic property estimates.

In addition to the slug testing program, three constant-rate withdrawal (pumping) tests were conducted at the LNP site (PEF 2009d): one within the surficial aquifer (at LNP Unit 2) and two within the Upper Floridan aquifer (LNP Units 1 and 2). Test response data were analyzed using the Multi-Layer Unsteady state (MLU) model of transient well flow in layered aquifer systems. Variability in observed aquifer response was indicative of the heterogeneous nature of the aquifers beneath the LNP site. An iterative analysis approach was required because analysis of the Upper Floridan aquifer data required as input the properties of the surficial aquifer, and analysis of the surficial aquifer data required as input the properties of the Upper Floridan aquifer. PEF adopted a composite analysis approach wherein a single set of hydraulic property values was determined that best matched the observed response at all available monitoring locations, rather than fitting separate sets of hydraulic properties to different locations. The MLU model tended to over-predict drawdown at some locations and under-predict drawdown at others. However, scatter plots comparing the observed and simulated drawdown response for all monitoring wells indicated a reasonable composite match of the data.

There was good agreement in hydraulic property estimates for tests conducted at the proposed LNP Units 1 and 2 locations, with horizontal hydraulic conductivity values for the Upper Floridan aquifer ranging from 120 to 130 ft/d and transmissivity values ranging from 62,000 to 69,000 ft^2/d (PEF 2009d). Comparison of these transmissivity estimates with values specified in a recalibrated version of the DWRM2 groundwater flow model (see model development discussion below) at this location (7900 to 250,000 ft^2/d) confirms that values derived from hydraulic tests conducted at the LNP site fall within the range specified in the model. Results for the surficial aquifer indicate that, as expected, this aquifer is much less permeable than the Upper Floridan aquifer, with estimated horizontal and vertical hydraulic conductivity values of 13 and 9 ft/d, respectively. Comparison of these hydraulic conductivity estimates with horizontal hydraulic conductivity values specified in the recalibrated DWRM2 groundwater flow model (PEF 2009f) at this location (0.7 to 85 ft/d) confirms that values derived from hydraulic tests conducted at the LNP site fall within the range specified in the model.

Potentiometric Surfaces

The simulated preconstruction potentiometric surface for the Floridan aquifer system, based on PEF's local-scale groundwater model (PEF 2009f), is generally consistent with regional descriptions provided by the USGS (USGS 2000, 2008a). The one exception is in the immediate vicinity of the LNP site where water-level data collected as part of the site investigation resulted in head values approximately 10 ft higher than indicated by the USGS potentiometric surface. This magnitude of difference is not unexpected given the regional scale of the USGS contour map and the fact that LNP site-specific data were not available for inclusion in the USGS interpretation. Although incorporation of site-specific water-level data did not significantly affect interpreted groundwater flow directions, the hydraulic gradient across the LNP site did decrease by approximately 25 percent relative to the original USGS interpretation. The resulting head contours, which are based on the USGS potentiometric surface with modifications in the vicinity of the LNP site to honor water-level data collected during the site investigation, show a potentiometric high to the east of the site and indicate that the direction of groundwater flow in the vicinity of the LNP site is generally west-southwest at an approximate gradient of 0.0009 (~5 ft/mi). Discharge areas for the Upper Floridan aquifer include areas where groundwater moves upward into the surficial aquifer, discharges to local springs, and discharges to offshore springs in the Gulf of Mexico.

Although no regional maps of the surficial aquifer phreatic surface appear to be available, the surficial aquifer is thin (approximately 50 ft in the vicinity of the LNP site) and is hydraulically connected to the Upper Floridan aquifer. Therefore, the surficial aquifer's phreatic surface is reasonably expected to closely mimic the potentiometric surface of the Upper Floridan aquifer. Primary discharge areas for the surficial aquifer are the Withlacoochee River and CFBC to the south and southwest of the site and the saltwater marshes that discharge to the Gulf of Mexico to the west of the site. Within the boundary of the LNP site, surface recharge associated with rainfall was specified in the DWRM2 groundwater flow model as generally ranging from 4 to 9 in./yr, with increased recharge (up to 19 in./yr) to the east of the site (PEF 2009f).

The relatively shallow, unconfined groundwater system is influenced by site topography, with groundwater flowing from a topographic high of approximately 60 ft above msl in the eastern portion of the site to a topographic low of approximately 30 ft in the southwest portion of the site. In the central portion of the site, where the topography is relatively flat, the water table is also relatively flat. Downward vertical gradients are maintained throughout the year between the surficial and Upper Floridan aquifers near the site of proposed LNP Units 1 and 2, but vertical gradients are expected to reverse in the vicinity of the discharge areas.

ER Section 2.3.1.5.4 (PEF 2009a) describes groundwater levels and movement for the LNP site. Potentiometric elevations in the aquifers beneath the LPN site are based on 2007 water-level monitoring data from observation and monitoring wells installed during the site investigation, including nested monitoring well pairs that measure vertical groundwater gradients and determine connectivity between the surficial and bedrock aquifers. Shallow wells were screened within the surficial aquifer, while intermediate and deep wells were screened completely within the limestone bedrock of the Upper Floridan aquifer. Water levels were measured quarterly in 2007, during which groundwater levels were observed to occur from between zero and 8 ft bgs. PEF also installed continuous water-level monitoring stations in two surficial aquifer-monitoring wells, one each within the footprint of the planned LNP Units 1 and 2 locations. Water-level data from the monitoring stations indicate that the water table fluctuated by as much as 5 ft from March 2007 through March 2008, with the highest levels in March and other shorter-duration peaks in August and October.

During the March 2007 high water-table conditions, monitoring data from nested wells at the proposed LNP Units 1 and 2 locations indicate a slightly higher hydraulic head (0.03 to 0.57 ft) within the surficial aquifer than in the bedrock aquifer, indicating a slight downward vertical gradient. During lower recharge periods, the water table drops by as much as 5 ft and the horizontal gradient flattens across the LNP site. Nested wells at the LNP Units 1 and 2 locations continued to show slightly higher hydraulic head within the surficial aquifer when compared with the bedrock aquifer. The direction (always downward) and magnitude of vertical gradients measured between the surficial and bedrock aquifers remained relatively constant throughout the monitoring period.

Water levels were also obtained from two nearby wells monitored by the USGS and having longer periods of record. These water levels were compared to the 1 year of LNP water-level data to assess any differences in longer-term trends. These wells are designated as USGS 290230082412501 Romp 125 Well at Crackertown, FL and USGS 290112082371101 CE 5 USGS OBSER WELL CE 5 NR INGLIS, FL. Both are completed in the Upper Floridan aquifer. Water levels were obtained from the USGS (USGS 2008b). Given the connectivity between the Upper Floridan and surficial aquifers at this site, the range in water levels should be comparable.

For the monitoring period encompassing the LNP pre-application field investigation (March 2007 through March 2008), water-level elevations in LNP wells varied by as much as 5.0 ft. During this same time period, water-level elevations in wells CE 5 and Romp 125 varied by as much as 4.0 and 4.1 ft, respectively. Over the expanded monitoring period provided by CE 5 (January 1968 through October 2008) and Romp 125 (August 1979 through October 2008), water-level elevations in these wells varied by as much as 6.5 and 7.7 ft, respectively. These longer-term data indicate that over a 30-to-40-year time frame, water levels in the vicinity of the proposed LNP wellfield can be expected to vary by as much as 7 to 8 ft due to normal seasonal climatic variability.

Model Development

PEF used a local-scale steady-state groundwater model, constructed as a requirement of its Florida Site Certification Application, to simulate predevelopment, current, and future potentiometric surfaces for the LNP site and vicinity (PEF 2009e). The local-scale model was a submodel of the SWFWMD's DWRM2 regional groundwater flow model. Because this DWRM2 model was calibrated to the USGS regional interpretation of the Upper Floridan aquifer potentiometric surface, which incorporated only limited information in the vicinity of the LNP site, a poor fit between simulated and observed heads in the vicinity of the LNP site was obtained (see discussion of the regional potentiometric surface above). To improve the goodness of fit over this portion of the model domain, which encompasses the proposed LNP wellfield and thus is important to the assessment of groundwater-use impacts, the model was recalibrated by PEF using both site-specific and regional head data. A detailed description of this model and the recalibration process is provided by PEF (2009d).

Calibration targets included in the recalibration process included (1) site water-level data, (2) water-level data from other USGS monitored wells within the model domain, and (3) additional measurement locations synthesized from the USGS potentiometric surface where no well coverage was available. The calibration was performed in the steady-state mode using 2007 water-level elevations and the Model-Independent Parameter Estimation (PEST) code (Doherty 2004). Head residuals for the recalibrated model (i.e., the difference between simulated and observed head values) ranged from −3.25 to 3.87 ft over the full model domain, and from −0.56 to 2.35 ft within the footprint of the LNP site. The resulting root mean square calibration error for the full model domain was 1.27 ft. PEF's model recalibration effort resulted in significant improvement in model fit where site-specific data was available at the LNP site. The resulting goodness-of-fit metrics indicate that the model is reasonably well calibrated to existing site conditions. This recalibrated model was used to assess the impacts of groundwater use at the LNP site (see Chapter 5).

2.3.2 Water Use

Consideration of water use requires estimating the magnitude and timing of consumptive and nonconsumptive water uses. Nonconsumptive water use does not result in a reduction in the available water supply. For example, water withdrawn from the CFBC and used to remove fish from the intake screens would result in no net change in water supply available to other CFBC water users if the same volume of water pumped from the CFBC would eventually be returned back into the CFBC. On the other hand, consumptive water use results in a net reduction of the water supply available for downstream users. For instance, the cooling-water system withdraws water for normal cooling. Most of that water is evaporated in the cooling towers, and that evaporated water would be considered a consumptive loss. The following two sections describe the consumptive and nonconsumptive users of surface water and groundwater near the LNP site.

2.3.2.1 Surface-Water Use

The FDEP primarily regulates approximately 6500 public water-supply systems in the state (FDEP 2009f). In 2008, 66 active public water systems were listed by the FDEP in Levy County (FDEP 2009g). All of these used groundwater as their source. FDEP listed 572 public water systems in Marion County that were active in 2008 (FDEP 2009h). None of them used a surface-water source. FDEP listed 177 public water systems in Citrus County that were active in 2008 (FDEP 2009i) and none of them used a surface-water source. PEF reported that there were no known sources of private water supply that used the Withlacoochee River or Lake Rousseau as their source (PEF 2009a).

PEF stated that, currently, no minimum in-stream flow requirements have been specified for the lower Withlacoochee River and that the SWFWMD may address this issue in 2011 (PEF 2009f).

2.3.2.2 Groundwater Use

As discussed in Section 2.3.1.2, the Upper Floridan aquifer is the main source of potable water (both private and municipal) and spring flow in west-central Florida. The surficial aquifer, which is thin, discontinuous, and low-yielding, is primarily used for irrigation and domestic use on a small scale. Neither of these aquifers is classified as a sole-source aquifer. Current and projected future groundwater use in the vicinity of the LNP site are discussed in ER Sections 2.3.2.3 and 2.3.4.4, respectively (PEF 2009a).

Current groundwater use near the LNP site was identified in three ways: using the SWFWMD and Suwannee River Water Management District well permitting database, using the FDEP's Source Water Assessment and Protection Program database, and performing a land-use survey. Permits are required for all wells located within the SWFWMD and Suwannee River Water Management District. Records indicate that between 1970 and 2007, approximately 55,000 well permits were issued within 25 mi of the LNP site. Of these permitted wells, approximately 77 percent were for domestic water supply, with the remaining wells used for industrial/fire protection (12 percent), irrigation (9 percent), and public water supply (2 percent). Based on these data sources, groundwater use by all permitted users within the boundary of the local-scale groundwater flow model used to assess LNP impacts (Figure 2-12) (PEF 2010), which is a submodel of the SWFWMD's DWRM2 regional groundwater flow model, was specified as 3.51 Mgd in 2001 (PEF 2009e).

Projected future groundwater use by all permitted users within the boundary of the local-scale groundwater flow model was also estimated by PEF based on population projections from the 2000 U.S. Census. This approach assumes that increases in permitted groundwater usage will be proportional to increases in population. Between 2001 and 2078, which is the anticipated LNP closure date (assuming startup in 2018, and 60 years of operation), the projected population increase was 293 percent. Given this population increase, projected future usage (not including the proposed LNP) would be expected to increase from 3.51 Mgd to 10.3 Mgd.

There is currently no groundwater use at the LNP site.

2.3.3 Water Quality

The following sections describe the quality of surface-water and groundwater resources in the vicinity of the LNP site. Monitoring programs for thermal and chemical water quality are also described.

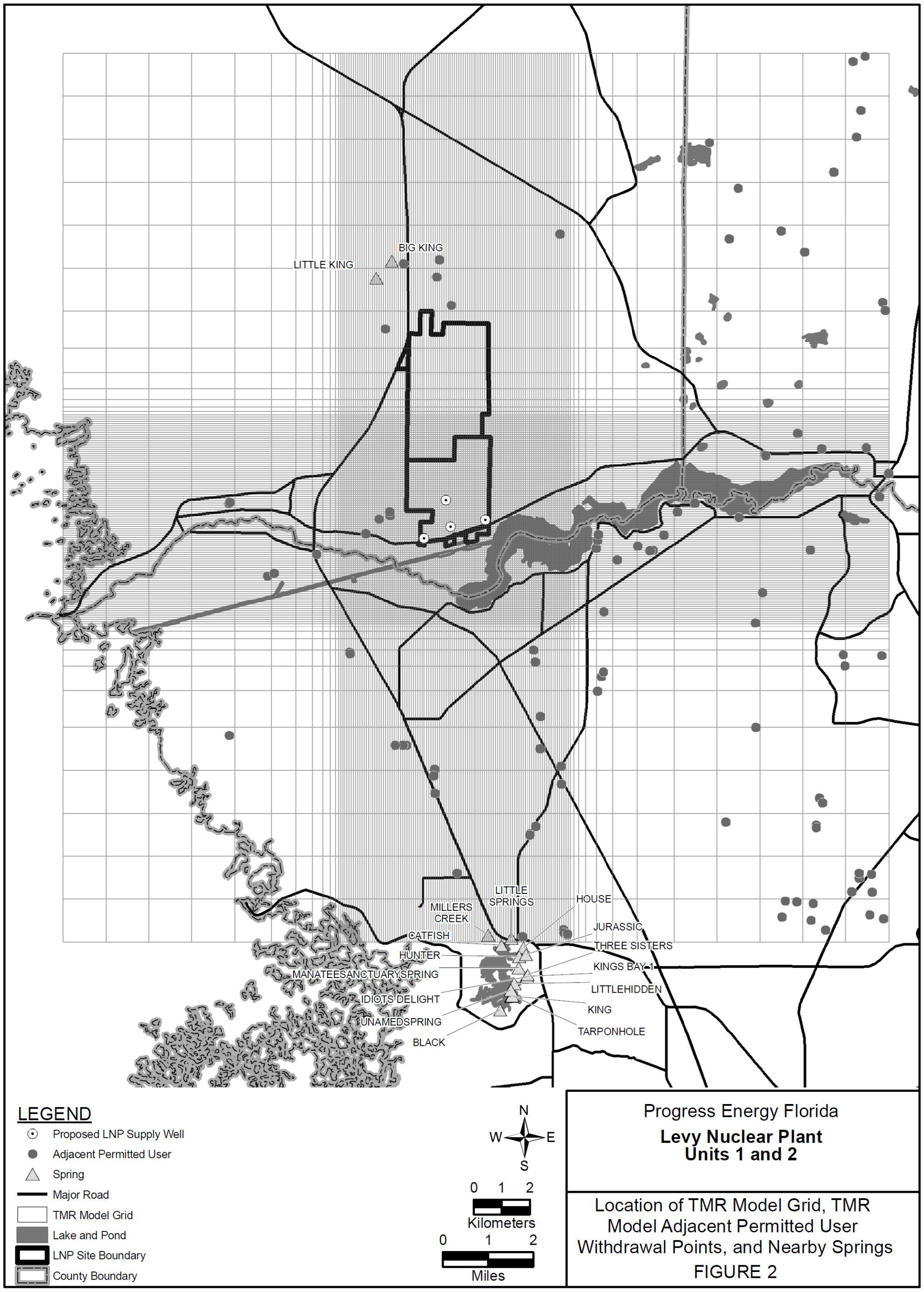


Figure 2-12. Local-Scale Model Grid Showing the Location of Proposed LNP Supply Wells, Adjacent Permitted Users, and Springs (PEF 2010)

2.3.3.1 Surface-Water Quality

PEF described water-quality sampling locations near the LNP site (Figure 2-13) that included six USGS stations, one station near the Inglis Lock bypass channel in Lake Rousseau (SS-2), four stations in the CFBC (stations 1–3, and SS-1), four stations in the Gulf of Mexico (stations 4–7), and four stations in the CREC discharge canal (Figure 2-14 and Table 2-3).

All six USGS stations are located on the Withlacoochee River. The USGS gauge 02313200, Withlacoochee River at Dunnellon, Florida, is located at the upstream end of Lake Rousseau (Figure 2-13). Based on water-quality data from May 1966 to April 2009 at this gauge, water temperature varies from 11.0 to 32.0°C (51.8 to 89.6°F) with a mean of 23.0°C (73.4°F); specific conductance varies from 165 to 804 μS/cm with a mean of 272 μS/cm; and dissolved oxygen varies from 0.9 to 13.2 mg/L with a mean of 6.4 mg/L. The USGS gauge 02313230, Withlacoochee River at Inglis Dam near Dunnellon, is located at the Inglis Dam near the downstream end of Lake Rousseau (Figure 2-13). Based on water-quality data from March 1963 to June 1999 at this gauge, water temperature varies from 10.5 to 35.0°C (50.9 to 95.0°F) with a mean of 24.4°C (75.9°F); specific conductivity varies from 152 to 462 μS/cm with a mean of 252 μS/cm; and dissolved oxygen varies from 0.4 to 14.0 mg/L with a mean of 6.5 mg/L. The USGS gauge 02313231, Withlacoochee River below Inglis Dam near Dunnellon, is located downstream of the Inglis Dam (Figure 2-13). Based on water-quality data from March 1963 to October 1984 at this gauge, water temperature varies from 10.5 to 32.0°C (50.9 to 89.6°F) with a mean of 23.5°C (74.3°F); specific conductivity varies from 155 to 11300 μS/cm with a mean of 513 μS/cm; and dissolved oxygen varies from 1.6 to 10.4 mg/L with a mean of 6.3 mg/L. The increased specific conductivity at this gauge reflects the influence of estuarine water that moves with the incoming tide upstream from the Gulf of Mexico via the CFBC and the OWR to just below the Inglis Dam.

The USGS gauge 02313250, Withlacoochee River bypass channel near Inglis, Florida, is located just downstream of the spillway that discharges water released from Lake Rousseau to the lower Withlacoochee River (Figure 2-13). Based on water-quality data from May 1971 to October 1984 at this gauge, water temperature varies from 14.0 to 30.0°C (57.2 to 86.0°F) with a mean of 23.5°C (74.3°F); specific conductivity varies from 210 to 380 μS/cm with a mean of 263 μS/cm; and dissolved oxygen varies from 2.8 to 11.4 mg/L with a mean of 6.6 mg/L. The USGS gauge 02313272, Withlacoochee River at Chambers Island near Yankeetown, Florida, is located on the north side of Chambers Island just before the river enters the Gulf of Mexico (Figure 2-13). Based on water-quality data from September 2005 to October 2008, water temperature varies from 14.6 to 32.9°C (58.3 to 91.2°F) with a mean of 24.6°C (76.3°F), and specific conductivity varies from 2020 to 39,500 μS/cm with a mean of 24,473 μS/cm. Increased influence of estuarine waters is evident in the specific conductivity data. The USGS gauge 02313274, Withlacoochee River at Bunglow Pass at Port Inglis, Florida, is located on the

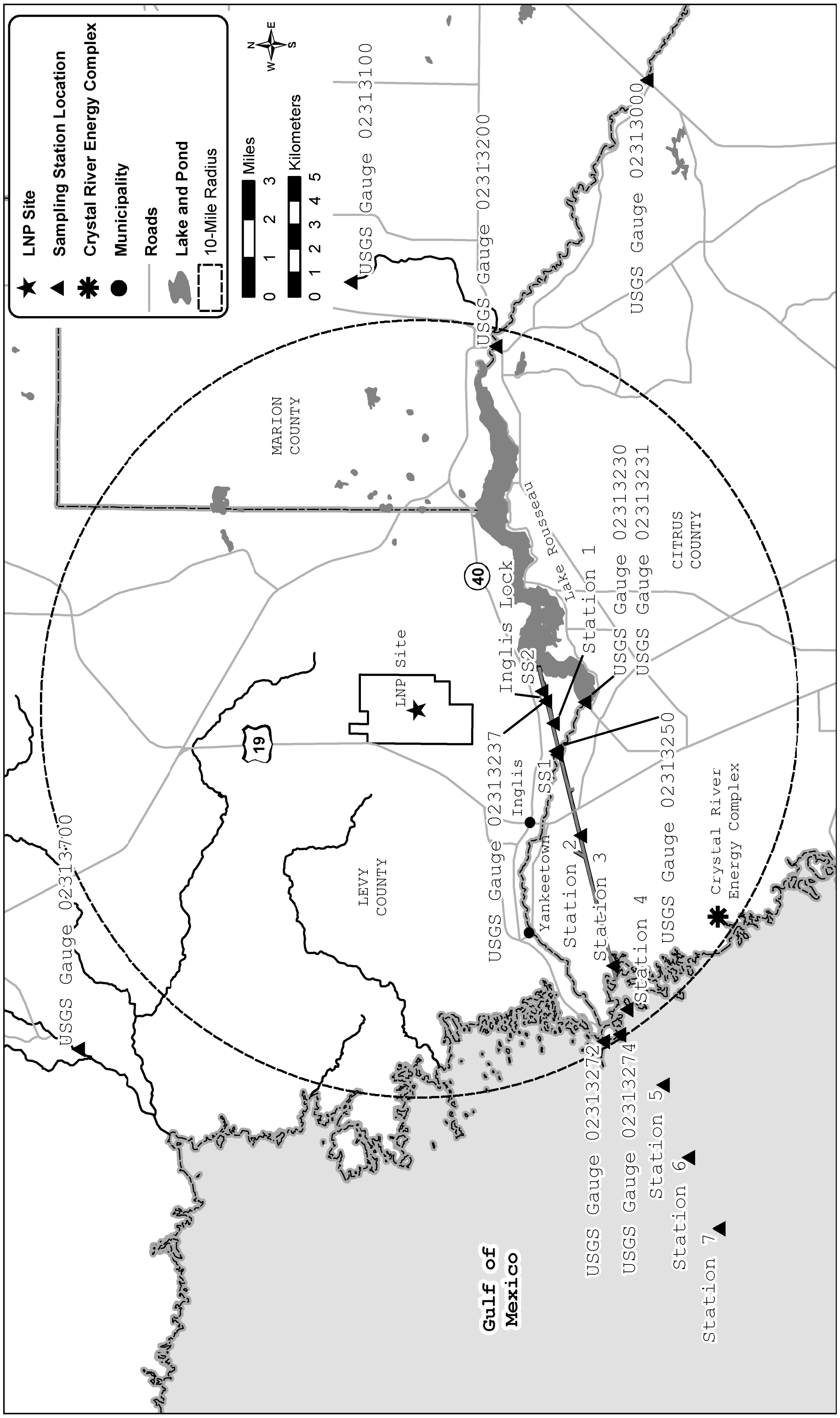


Figure 2-13. Water-Quality Sampling Stations for the Proposed LNP Units (PEF 2009a)

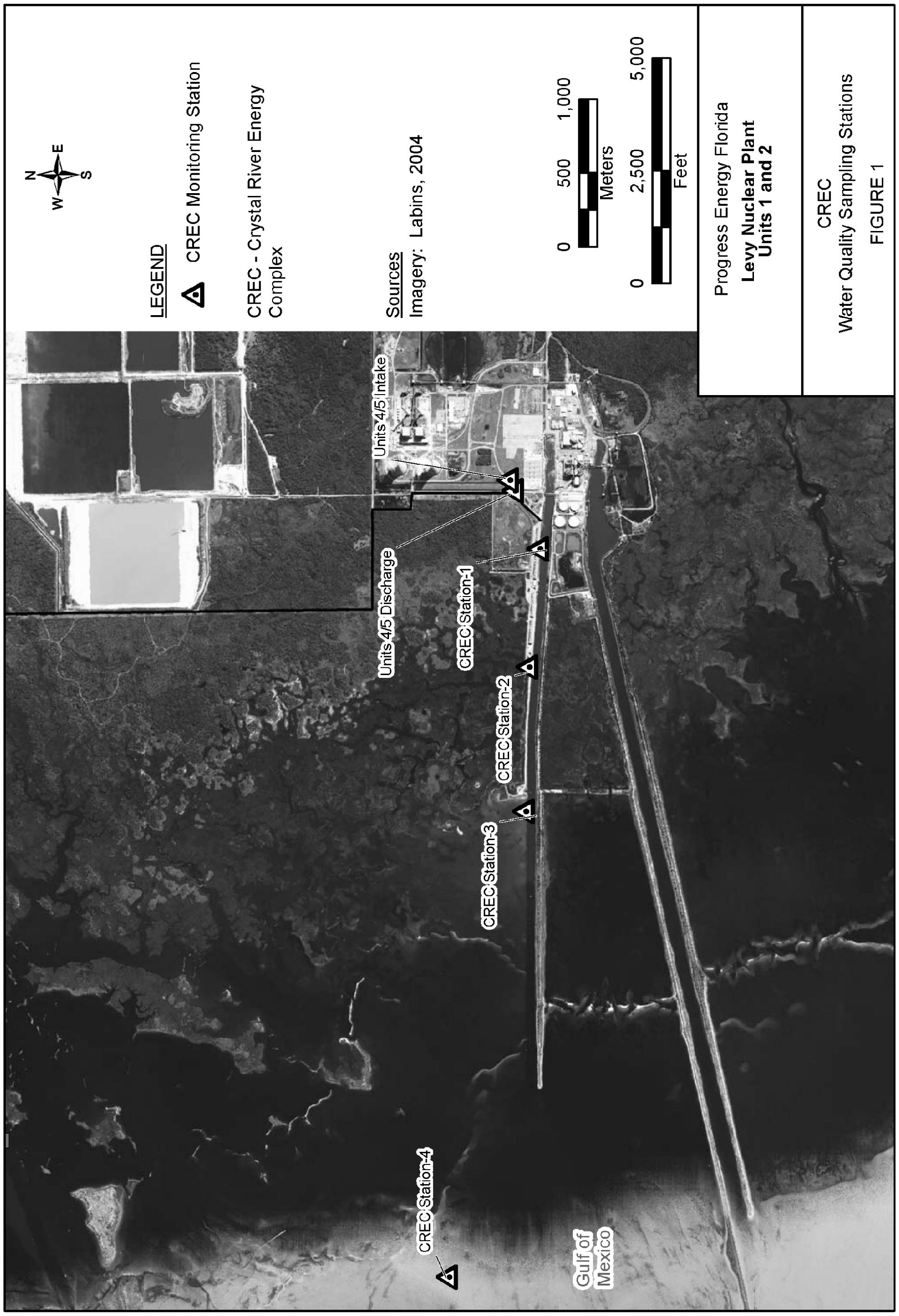


Figure 2-14. Water-Quality Sampling Stations for the CREC Discharge Canal (PEF 2009d)

Table 2-3. Water-Quality Sampling in the CFBC, the Gulf of Mexico, and the CREC Discharge Canal

Water Body	Station	Sampling Dates	Sampled Parameters
CFBC	Station 1	10/16/2007, 10/19/2007	List 1
	Station 2	10/16/2007, 11/19/2007	List 1
	Station 3	10/16/2007, 11/19/2007	List 1
		12/10/2007, 12/12/2007	Temperature
	SS-1, SS-2	3/8/2007, 6/14/2007, 9/13/2007, 12/4/2007	List 2
Gulf of Mexico	Station 4	10/16/2007, 11/19/2007	List 1
		12/10/2007, 12/12/2007	Temperature
	Station 5	10/16/2007, 11/19/2007	List 1
	Station 6	10/16/2007, 11/19/2007	List 1
	Station 7	10/16/2007, 11/19/2007	List 1
CREC Discharge Canal	CREC Station 1	9/2/2008, 11/17/2008, 2/4/2009, 5/19/2009	List 3
	CREC Station 2	9/2/2008, 11/17/2008, 2/4/2009, 5/19/2009	List 3
	CREC Station 3	9/2/2008, 11/17/2008, 2/4/2009, 5/19/2009	List 3
	CREC Station 4	9/2/2008, 11/17/2008, 2/4/2009, 5/19/2009	List 3
	CREC Units 4 and 5 Intake	10/16/2008	List 3
		1/14/2009, 2/3/2009, 5/19/2009 8/18/2009	List 3 List 4
	CREC Units 4 and 5 Discharge	10/16/2008	List 3
		1/14/2009, 2/3/2009, 5/19/2009 8/17/2009	List 3 List 4

Sources: PEF 2009a, m, n

List 1 Temperature; Dissolved Oxygen; Specific Conductivity; Salinity; pH; Secchi Depth; and Total Depth

List 2 Temperature; Dissolved Oxygen; Conductivity; Salinity; pH; Oxygen Reduction Potential; and Turbidity

List 3 Total Dissolved Solids; Total Suspended Solids; Ammonia; Kjeldahl Nitrogen; Nitrite as N; Phosphorus; Chlorophyll a; Pheophytin-a; Chlorophyll a corrected for Pheophytin; Biochemical Oxygen Demand; Chemical Oxygen Demand; Orthophosphate; Alkalinity; Chlorides; Sulfate; Sodium; Potassium; Calcium; Magnesium; Mercury; and Lead

List 4 Gross Alpha; Radium 226; Radium 228; Temperature; Dissolved Oxygen; Conductivity; Salinity; and pH

south side of Chambers Island just before the river enters the Gulf of Mexico (Figure 2-13). Based on water-quality data from November 2005 to October 2008, water temperature varies from 13.3 to 32.4°C (55.9 to 90.3°F) with a mean of 24.4°C (75.9°F) and specific conductivity varies from 4730 to 44,500 µS/cm with a mean of 26,264 µS/cm. Increased influence of estuarine waters is evident in the specific conductivity data.

PEF conducted water-quality sampling in the CFBC, the Gulf of Mexico, and the CREC discharge canal (Figure 2-13, Table 2-3). For the sampling stations in the CFBC, PEF reported the average temperature in the water column to vary from 21.3 to 23.4°C with surface temperature varying from 20.1 to 29.1°C (PEF 2009a). PEF observed no stratification of temperature over the depth water temperatures were measured, 0.15 to 5 m. PEF reported no observed stratification of temperature in the Gulf of Mexico, and the average temperature in the water column varied from 20.3 to 22.1°C (PEF 2009a).

For sampling stations 1–3 in the CFBC, PEF reported the average dissolved oxygen in the water column to vary from 3.7 to 4.6 mg/L with the surface measurements at station SS-1 varying from 0.5 to 8.2 mg/L (PEF 2009a). Dissolved oxygen was observed to decrease slightly with depth, whereas in the Gulf of Mexico dissolved oxygen increased from east to west with temporal variations at stations 6 and 7. The average dissolved oxygen in the water column to vary from 4.2 to 5.8 mg/L (PEF 2009a).

For sampling stations 1–3 in the CFBC, PEF reported the average specific conductivity in the water column to vary from 34.9 to 40.2 µS/cm and the surface specific conductivity measured at Station SS-1 to vary from 1.9 to 15.7 µS/cm (PEF 2009a). The specific conductivity was observed to increase with depth, and, in the Gulf of Mexico, it exhibited an increase from east to west with average values that varied from 44.6 to 52.7 µS/cm and stratification (specific conductivity increasing with depth) was observed only at Station 4 (PEF 2009a).

For the sampling stations in the CFBC, PEF reported the median pH to vary from 7.6 to 7.9 standard units (SUs) with only slight variation with depth (PEF 2009a). In the Gulf of Mexico, PEF observed no stratification and no spatial or temporal trend in pH, with the measured values varying from 7.9 to 8.1 SU (PEF 2009a).

The salinity in the Gulf of Mexico was observed to increase from east to west with the average salinity varying from 29.9 to 34.7 parts per thousand (PEF 2009a). PEF observed a salinity stratification at station 4 that showed salinity increasing with depth.

Currently, the CREC discharge canal is used by CREC Units 1–5 to discharge cooling water to the Gulf of Mexico. The CREC units' discharge to the Gulf of Mexico is allowed by the FDEP via an existing NPDES permit. CREC Unit 3, a nuclear power plant, is scheduled to be uprated. PEF's application to the state of Florida for the uprate was approved in August 2008 and the USACE has issued a public notice (USACE 2010). PEF is expected to submit an application for the uprate to the NRC in 2010. The cooling-water flow rate for CREC Unit 3 would remain the same, but the thermal load would increase (PEF 2009k). A new helper cooling tower, located on the south bank of the discharge canal, would be used to cool the discharged waters in the canal during critical summer months to meet the NPDES permit requirements.

The FDEP, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b), prepares a statewide Water Quality Inventory. The FDEP also identifies impaired waterbodies during this process and lists them on the 303(d) List. Lake Rousseau and the lower Withlacoochee River appear on the draft 2010 303(d) List as impaired waterbodies because of the presence of mercury in fish tissue (FDEP 2010b).

Proposed LNP Units 1 and 2 would discharge cooling-tower blowdown and other treated wastes to the CREC discharge canal for eventual disposal into the Gulf of Mexico. These discharges would be regulated by a National Pollutant Discharge Elimination System (NPDES) permit.

2.3.3.2 Groundwater Quality

Groundwater samples were collected from four wells during quarterly monitoring in 2007 for water-quality determination (PEF 2009a). Measured field parameters (and observed range in temporally averaged values at each location) included pH (6.45 to 7.01 SU), specific conductance (0.341 to 0.532 µS/cm), dissolved oxygen (0.17 to 0.27 mg/L), and temperature (22.0 to 23.1°C). Additional groundwater analytes included carbon dioxide, total dissolved solids, total suspended solids, hardness, chlorine, sulphate, sulphide, alkalinity, bicarbonate, nitrogen (ammonia, total, and nitrate-nitrite), phosphorus, orthophosphate, biological oxygen demand, chemical oxygen demand, total organic carbon, and trace metals. Concentrations of metals were reported for arsenic, boron, calcium, chromium (total), copper, iron, lead, magnesium, manganese, nickel, potassium, silica, sodium, zinc, and mercury. For all analytical parameters that have primary drinking water standards in the State of Florida, none exceeded the maximum permissible contaminant level.

Monitoring results indicate groundwater near the LNP site is a calcium bicarbonate type water that is typical of this part of Florida (USGS 2000). Total dissolved solids are within acceptable limits for potable groundwater and analytes such as nitrate that may indicate contamination are generally low.

Two of the wells monitored the surficial aquifer and two wells monitored the Upper Floridan aquifer. Average specific conductance, salinity, and alkalinity values were lower for surficial aquifer well MW-13S (340 µS/cm, 170 mg/L, and 160 mg/L, respectively) than average values for the other three wells (510 µS/cm, 270 mg/L, and 280 mg/L, respectively), which might indicate a stronger influence from surficial recharge at this location. Water-quality parameters for the other surficial aquifer well were comparable to those for the two Upper Floridan aquifer wells, providing additional evidence of connectivity between these two aquifer systems.

Nothing in the analyses suggested any unusual chemical conditions. The December 2007 sampling event did indicate unusual values for both chemical oxygen demand and oxidation-reduction potential. Chemical oxygen demand was elevated during this sampling event, most significantly at the MW-13S/14D well pair where the deep well saw an increase from <20 to 240 mg/L. Oxidation-reduction potential also decreased during this sampling event, indicating more reducing conditions. PEF reviewed these results and identified no data errors (PEF 2009d). One possible explanation is that the December sampling event was preceded by a relatively dry period, resulting in decreased recharge rates that may have affected aquifer geochemistry; rainfall that infiltrates into the surficial aquifer is typically more acidic and oxygenated than groundwater. However, given the limited groundwater-monitoring data available, confirmation of any seasonal recharge-related impacts was not possible. In addition, if decreased recharge was responsible for the observed response, similar results would be expected (but were not observed) for the June 2007 sampling event, which was also preceded by relatively dry conditions. All monitored analytical parameters that have drinking water standards in the State of Florida were within limits.

Excessive use of the groundwater resource in coastal regions has the potential to increase the likelihood and/or magnitude of saltwater intrusion. If the intruding saltwater reaches locations where freshwater is used, the value of the resource may be diminished considerably. The potential for vertical migration of saline waters from deeper Floridan aquifer intervals exists at the site (PEF 2009d). The occurrence of brackish water in deeper intervals beneath the LNP site has not been confirmed by monitoring data, but it can be expected to occur at depths greater than those explored at the site, based on the common occurrence of deep saline groundwater in Florida (USGS 2000).

2.3.4 Water Monitoring

Surface-water and groundwater monitoring at and near the proposed site are described below.

2.3.4.1 Surface-Water Monitoring

Surface-water data are available for several USGS streamflow stations near the LNP site. A brief summary of the observations at these streamflow stations is provided in Table 2-4.

Mean monthly discharge in the Withlacoochee River at Holder varies from 553 cfs in June to 1590 cfs in September. Mean monthly specific conductance at Holder varies from 277 μS/cm to 335 μS/cm in August. Above the Inglis Dam on Lake Rousseau, 179 cfs in June to 758 cfs in October. The discharge through Lake Rousseau to the lower Withlacoochee River via the Inglis Lock bypass channel and spillway varies from 923 cfs in May and June to 1110 cfs in September. Monthly salinity at Yankeetown varies from 0.4 parts per thousand (ppt) to about 2 ppt in March. Monthly bottom salinity at Chambers Island is observed to be 12.3 ppt in July and 16 ppt in May. These data are consistent with freshwater in the upper reaches of the Withlacoochee River and increasingly saline water as the lower Withlacoochee River reaches the Gulf of Mexico.

In addition to the surface-water monitoring parameters listed in Table 2-4, these locations are also sampled for water-quality parameters including turbidity, dissolved oxygen, biochemical oxygen demand, pH, biomass, nutrients, organisms, pesticides, and metals.

PEF collected and analyzed quarterly samples at two stations, SS1 and SS2, during 2007 as part of the preapplication monitoring (Figure 2-13). PEF also collected samples at seven locations in the CFBC and the Gulf of Mexico during October and December 2007 (Figure 2-13). The monitored water-quality parameters included temperature, salinity, dissolved oxygen, pH, conductivity, oxygen reduction potential, and turbidity (PEF 2009a). The data appear in Section 2.3.3.1 of the ER (PEF 2009a) and are discussed in Section 2.3.3.1.

Table 2-4. Surface-Water Monitoring at USGS Streamflow Stations near the LNP Site

Station Name (number)	Period of Record	Parameter(s)
Withlacoochee River near Holder, Florida (USGS 02313000)	March 7, 1987 – July 12, 2006	Mean Daily Water Temperature
	September 1, 1928 – May 17, 2010	Mean Daily Discharge
	March 7, 1987 – July 12, 2006	Mean Daily Specific Conductance
Withlacoochee River at Dunnellon, Florida (USGS 02313200)	February 6, 1963 – May 17, 2010	Mean Daily Gauge Height
	November 11, 2000 – May 17, 2010	Total Daily Precipitation
Withlacoochee River at Inglis Dam near Dunnellon, Florida (USGS 02313230)	October 1, 1969 – February 13, 2010	Mean Daily Discharge
	October 1, 1985 – May 17, 2010	Mean Daily Gauge Height
Withlacoochee River below Inglis Dam near Dunnellon, Florida (USGS 02313231)	October 1, 1969 – May 17, 2010	Mean Daily Gauge Height
Withlacoochee River Bypass Channel near Inglis, Florida (USGS 02313250)	January 1, 1970 – May 18, 2010	Mean Daily Discharge
	July 16, 1971 – May 17, 2010	Mean Daily Gauge Height
Withlacoochee River at Yankeetown, Florida (USGS 02313267)	March 8, 1984 – September 15, 1985	Daily Minimum, Maximum, and Mean Salinity
Withlacoochee River near Yankeetown, Florida (USGS 02313269)	April 5, 1984 – September 30, 1985	Daily Minimum, Maximum, and Mean Salinity
Withlacoochee River at Chambers Island near Yankeetown, Florida (USGS 02313272)	March 9, 1984 – October 17, 1985	Daily Minimum, Maximum, and Mean Bottom Salinity
	May 4, 1984 – May 17, 2010	Minimum, Maximum, Mean, and Tidal Daily Gauge Height
	January 28, 2005 – May 7, 2010	Daily Minimum and Maximum Top Specific Conductance
	January 27, 2005 – May 7, 2010	Daily Minimum and Maximum Bottom Specific Conductance
	January 27, 2005 – May 17, 2010	Daily Minimum and Maximum Top Water Temperature
Withlacoochee River at Bungalow Pass at Port Inglis, Florida (USGS 02313274)	July 8, 2005 – May 17, 2010	Daily Mean Tidal Gauge Height
	March 30, 2005 – April 25, 2010	Minimum and Maximum Top Specific Conductance
	April 19, 2005 – May 17, 2010	Minimum and Maximum Bottom Specific Conductance
	March 30, 2005 – May 17, 2010	Daily Minimum and Maximum Top Water Temperature
	April 19, 2005 – May 17, 2010	Daily Minimum and Maximum Bottom Water Temperature

Source: PEF 2009a

2.3.4.2 Groundwater Monitoring

Pre-application monitoring of the groundwater system underlying the LNP site included four quarterly sampling events (March, June, September, and December 2007) in four newly constructed monitoring wells. Two of the wells monitored the surficial aquifer and two wells monitored the Upper Floridan aquifer. One well pair was located at the proposed LNP Unit 1 site and the other was located at the proposed LNP Unit 2 site. The data appear in tables presented in Section 2.3.3.2 of the ER (PEF 2009a) and are discussed above in Section 2.3.3.2.

2.4 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by the proposed action. Sections 2.4.1 and 2.4.2 provide general descriptions of terrestrial and aquatic environments on the LNP site and in the vicinity of the proposed associated offsite facilities required to support the development and operation of the LNP site, including the proposed transmission-line corridors.

Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from building, operating, and maintaining the new nuclear power generating facilities and transmission-lines. The descriptions also support the evaluation of mitigation activities to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions are also provided to aid in comparing the alternative sites to the LNP site in Chapter 9. Also included are descriptions of proposed monitoring programs for terrestrial and aquatic environments.

2.4.1 Terrestrial and Wetland Ecology

This section describes terrestrial ecological resources, including wetlands, and discusses species composition and other structural and functional attributes of biotic assemblages that could be affected by actions proposed on the LNP site and the corridors for associated offsite facilities. The proposed offsite facilities include:

- transmission-lines and associated infrastructure (e.g., substations and access roads)
- barge slip on CFBC
- heavy-haul road
- makeup and blowdown pipelines
- CWIS on the CFBC
- groundwater wellfield to supply general plant operations
- various access roads to the proposed LNP site, transmission lines, and barge slip.

Portions of the transmission lines, pipelines, and heavy-haul road designed to be built within the 3105-ac LNP site are considered part of the site work and not part of the offsite facility work. All work designed as offsite facility work lies outside of the perimeter of the 3105-ac LNP site. This section also identifies "important" terrestrial resources, as defined in NUREG-1555 (NRC 2000), including (but not limited to) threatened and endangered species and commercially or recreationally valuable species that might be affected by the proposed action.

2.4.1.1 Terrestrial Resources – Site and Vicinity

The 3105-ac LNP site is located in the Gulf Coastal Flatwoods ecoregion of Florida (EPA 2007). The Gulf of Mexico is located about 7.9 mi west of the LNP site and Lake Rousseau lies about 3 mi to the south. Goethe State Forest borders the northeast part of the LNP site. A pine plantation is just east and south of the LNP site, and an exotic animal hunting ranch and US-19 border the western edge of the LNP site.

The LNP site and vicinity are characterized by broad, low-elevation flatlands interspersed with shallow depressions. Pine flatwoods were the predominant vegetative community prior to the mid-20th century, but most have been converted from natural longleaf pine (*Pinus palustris*) and slash pine (*P. elliottii*) communities to managed forests stocked with slash pine and loblolly pine (*P. taeda*). The LNP site is undeveloped except for a network of limerock roads. Prior to being acquired by PEF, the site was in active forest management and leased for hunting and target practice. Vegetation, soils, and localized drainage patterns had been extensively altered through forest plantation activities including clearing, logging, road development, ditching, grading, bedding, and replanting. Localized vegetation disturbance has occurred as PEF has performed various site investigations including geotechnical boring, installation of groundwater wells, and placement of a meteorological tower on the LNP site.

Existing Cover Types (Habitats)

The LNP site supports a range of cleared and forested cover types that have been influenced by intensive forest management. Existing cover types have been identified and mapped using the Florida Land Use, Cover and Forms Classification System (FLUCFCS). The distribution of upland and wetland cover types is described below based on maps prepared by the SWFWMD and field surveys conducted by CH2M Hill Nuclear Business Group (CH2M Hill), a subcontractor to PEF, between September 2006 and November 2008. SWFWMD FLUCFCS mapping for the LNP site and vicinity is presented in Figure 2-15 to illustrate the general distribution of cover types in the area.

The area of each cover type found on the LNP site is presented in Table 2-5. A brief description of each cover type, summarized from the ER (PEF 2009a), PEF responses to Requests for Additional Information (RAIs) (PEF 2009b), and Florida Department of Transportation (FDOT 1999) is provided below in order of decreasing areal extent on the LNP site.

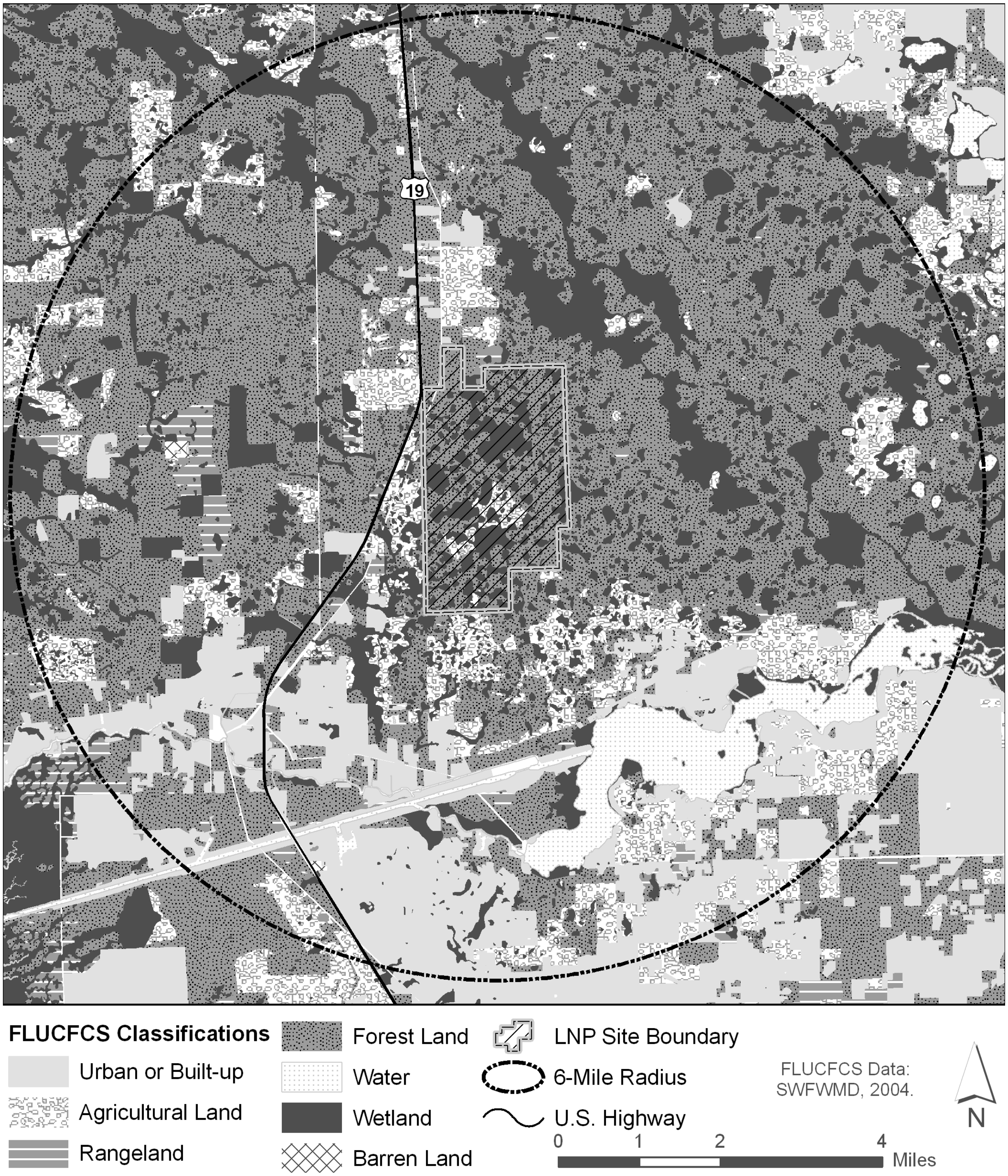


Figure 2-15. Cover Types from the LNP Site and Vicinity

Table 2-5. Area of Cover Types at the LNP Site

Cover Type	FLUCFCS Code[(a)]	Approximate Acres	Approximate Percent of LNP Site
Coniferous plantations	441	962.9[(b)]	31.0
Wet planted pine	629	812.7	26.1
Cypress swamp	621	402.6	12.9
Mixed wetland hardwoods	617	317.6	10.2
Treeless hydric savanna	646	274.4	8.8
Wetland forested mixed	630	156.4	5.0
Other open lands (rural)	260	106.0	3.4
Freshwater marshes	641	23.5	0.8
Hardwood conifer mixed	434	16.0	0.5
Wet prairie	643	14.3	0.5
Upland coniferous forest	410	11.0	0.4
Utilities	830	4.0	0.1
Pine flatwoods	411	3.0	0.1
Shrub and brushland	320	0.6	<0.1
Total cover types		3105.0	

Sources: PEF 2009a, b.

(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System (FDOT 1999).

(b) Derived by subtracting area for wet planted pine (as determined from wetland delineation) from original ER estimate for tree plantations. Area of tree plantation was reduced by 4.4 ac to account for boundary adjustments.

Coniferous Plantations (FLUCFCS 441)

Coniferous plantations encompass approximately 962.9 ac or 31.0 percent of the LNP site. They occupy most uplands on the site. Most coniferous plantations are monospecific, even-aged stands planted in slash pine, and to a lesser extent loblolly pine. They have been managed on a short harvest rotation of less than 30 years. A range of stand conditions are found on the LNP site, from recently planted seedlings to early-maturity pine stands. After past clear-cut harvests the land has been graded, bedded, and replanted with pine seedlings. The understory and groundcover are generally sparse and include gallberry (*Ilex glabra*), saw palmetto (*Serenoa repens*), sand blackberry (*Rubus cuneifolis*), wax myrtle (*Myrica cerifera*), wiregrass (*Aristida stricta* var *beyrichiana*), broomsedge bluestem (*Andropogon virginicus*), marsh bristlegrass (*Setaria geniculata*), blue maidencane (*Amphicarpum muhlenbergianium*), clustered bush mint (*Hyptis alata*), muscadine (*Vitis rotundifolia*), and greenbrier (*Smilax* spp.) (PEF 2009a).

Wet Planted Pine (FLUCFCS 629)

Coniferous plantations in areas subject to ground saturation or inundation encompass approximately 812.7 ac or 26.1 percent of the LNP site. They tend to occur in drier wetlands where natural wetland vegetation has been cleared and replaced by planted rows of commercial pine seedlings, mostly as slash pine, that can tolerate limited ground saturation or inundation. These areas tend to be shown on FLUCFCS maps using the same numerical code (441) as upland pine plantations. As for coniferous plantations in drier parts of the site, areas of wet planted pine comprise even-aged stands of planted pine that have been managed on a short harvest rotation of less than 30 years. Stand conditions range from recently planted seedlings to early-maturity pine stands. After past clear-cut harvests, the land has been graded, bedded, and replanted with pine seedlings. Planted slash pine is predominant in the tree canopy. Also present is a sparse groundcover of moisture-tolerant herbaceous species such as blue maidencane, broomsedge bluestem, Virginia chain fern (*Woodwardia virginica*), and yellow-eyed grass (*Xyris* spp.), along with scattered shrubs such as fetterbush (*Lyonia lucida*) and gallberry (PEF 2009b).

Cypress (FLUCFCS 621)

Cypress swamp encompasses 402.6 ac or 12.9 percent of the LNP site. Cypress swamps occur as isolated, circular depressions or occupy shallow sloughs or drainage ways linked during seasonally wet periods. Tree canopy is dominated by pond cypress (*Taxodium ascendens*). Other woody species include slash pine, red bay (*Persea borbonia*), swamp tupelo (*Nyssa sylvatica* var *biflora*), red maple (*Acer rubrum*), common buttonbush (*Cephalanthus occidentalis*), fetterbush, Virginia willow (*Itea virginica*), and swamp doghobble (*Leucothoe racemosa*) (PEF 2009a). Groundcover is generally sparse due to seasonally high water, but includes lizard's tail (*Saururus cernuus*), blue maidencane, and ferns that frequently grow in elevated tussocks, such as royal fern (*Osmunda regalis*), cinnamon fern (*Osmunda cinnamomea*), and Virginia chain fern (PEF 2009a).

Mixed Wetland Hardwoods (FLUCFCS 617)

Forests in wetland settings dominated by a mixture of hardwood tree species encompass approximately 317.6 ac or 10.2 percent of the LNP site. Dominant canopy species include red bay, sweetbay (*Magnolia virginiana*), red maple, dahoon (*Ilex cassine*), and pond cypress. Common shrubs include common button bush, fetterbush and wax myrtle (PEF 2009b). This cover type occurs mostly in cutover cypress swamps where fire suppression has allowed hardwood species to proliferate.

Treeless Hydric Savanna (FLUCFCS 646)

Approximately 274.4 ac (or 8.8 percent) of the LNP site have been identified by PEF as treeless hydric savanna. These areas are clear-cut wetland forest stands that have not yet been replanted (or allowed to naturally regenerate tree cover) (PEF 2009g). They are largely vegetated by wet prairie species such as broomsedge bluestem, pipeworts (*Eriocaulon* spp.), yellow-eyed grass, and wiregrass (PEF 2009b). Shrubs such as fetterbush and wax myrtle are also present.

Wetland Forested Mixed (FLUCFCS 630)

Approximately 156.4 ac (or 5.0 percent) of the LNP site have been identified by PEF as wetland forested mixed. This cover type includes mixed wetland forest communities in which neither hardwoods nor conifers dominate the tree canopy (FDOT 1999). On the LNP site, this cover type frequently occurs as inclusions in, or on the periphery of, cypress swamps. Tree canopy cover is similar to that in cypress swamps (FLUCFCS 621) but with a higher prevalence of hardwood trees such as redbay, sweetbay, tupelo (*Nyssa* sp.), red maple, and dahoon (PEF 2009a). This cover type is distinguished from mixed wetland hardwoods (FLUCFCS 617) by a higher conifer levels (especially cypress) in the tree canopy.

Other Open Lands – Rural (FLUCFCS 260)

Other open lands – rural cover type (106 ac or 3.4 percent of the LNP site) – are represented on the site by recently clear-cut upland areas that have been heavily scarified. They contain scattered piles of woody debris and a network of logging roads. Common plants in these areas include broomsedge bluestem, Carolina redroot (*Lachnanthes caroliana*), dog fennel (*Eupatorium capillifolium*), annual ragweed (*Ambrosia artemisiifolia L.*), red top panicum (*Panicum rigidulum*), bracken fern (*Pteridium aquilinum*), and slash pine saplings (PEF 2009a).

Freshwater Marshes (FLUCFCS 641)

Freshwater marshes, present on about 23.5 ac or 0.8 percent of the LNP site, are dominated mostly by grasses, sedges, and forbs tolerant of wet conditions. Most freshwater marshes on the LNP site appear to be successional habitats that developed after cypress swamps or pine flatwoods were logged. These areas are generally wetter than treeless hydric savannah (FLUCFCS 646) or wet prairie (FLUCFCS 643). The vegetative composition is dependent upon hydroperiod, the community present prior to disturbance, and time since disturbance. Freshwater marshes may occur as small shallow depressions within planted pine stands, in clearings, and in borrow areas for road development and bedding. Common species include maidencane (*Panicum hemitomon*), blue maidencane, bushy bluestem (*Andropogon glomeratus*), sand cordgrass (*Spartina bakeri*), Jamaica swamp sawgrass (*Cladium jamaicense*), yellow-eyed grass, Carolina redroot, bogbutton (*Lachnocaulon* spp.), spikerush

(*Eleocharis* spp.), creeping primrose-willow (*Ludwigia repens*), sedges (*Carex* spp.), and beaksedge (*Rhynchospora* spp.), with groundsel bush (*Baccharis halimifolia*), St. Andrew's Cross (*Hypericum hypericoides*), and common buttonbush (PEF 2009a). Some depressional marshes on the LNP site exist as shallow basins containing concentric bands of herbaceous and shrub vegetation. The central portion of these areas is vegetated by emergent species such as pickerelweed (*Pontedaria cordata*), firelag (*Thalia geniculata*), and broadleaf cattail (*Typha latifolia*) (PEF 2009a). Shrubs such as common buttonbush, St. Peterswort (*Hypericum crux-andreae*), St. Andrew's cross, and wax myrtle surround these depressional wetlands. Some logged cypress stands may include scattered pond cypress trees left as a seed source for stand regeneration.

Hardwood Conifer Mixed (FLUCFCS 434)

The hardwood conifer mixed cover type describes upland forests where conifers and hardwoods share dominance in the tree canopy. Distribution of this cover type on the site is limited to a small area (16 ac or 0.5 percent of the LNP site) in the northwestern corner just east of US-19/US-98. Common species include laurel oak (*Quercus laurifolia*), sweet gum (*Liquidambar styraciflua*), slash pine, loblolly pine, live oak (*Quercus virginiana*), and cabbage palm (*Sabal palmetto*) (PEF 2009a).

Wet Prairie (FLUCFCS 643)

Wet prairies, about 14.3 ac, make up about 0.5 percent of the LNP site acreage. Wet prairie is characterized as an infrequently inundated treeless plain with a sparse-to-dense groundcover of grasses and herbs. It is usually distinguished from freshwater marshes by having less water and shorter herbage (FDOT 1999). Common vegetation includes bushy bluestem , soft rush (*Juncus effusus*), dog fennel, spadeleaf (*Centella asiatica*), torpedo grass (*Panicum repens*), meadow beauty (*Rhexia* spp.), St. John's-wort (*Hypericum* sp.), camphorweed (*Pluchea* spp.), bog button, maidencane, and marshpennywort (*Hydrocotyle* spp.) (Golder Associates 2008).

Upland Coniferous Forest (FLUCFCS 410)

The upland coniferous forest cover type is defined as a natural forest stand in which at least 66 percent of the canopy is dominated by conifers and that does not meet the criteria for a more detailed classification. It is used in this document to identify naturally vegetated upland areas dominated by pines that do not meet the narrower definition of pine flatwoods (FLUCFCS 411). This cover type, making up about 11 ac or 0.4 percent of the LNP site, is represented by small isolated patches of natural pine forest that do not meet the definition for pine flatwoods (FLUCFCS 411). Nearly all uplands on the LNP site capable of supporting natural pine forest have either been converted to planted pine forest (i.e., coniferous plantations) or recently harvested (PEF 2009a).

Utilities (FLUCFCS 830)

The utilities cover type (4.0 ac or 0.1 percent of the LNP site) is represented by a natural-gas pipeline corridor in the northwest corner of the site, roughly parallel to US-19/US-98. Vegetation within the corridor is maintained in a herbaceous-to-shrub condition. Early successional species predominate, such as dog fennel, bluestem (*Andropogon* spp.), goldenrod (*Solidago* spp.), bracken fern, slender flat-top goldenrod (*Euthamia caroliniana*), winged sumac (*Rhus copallina*), groundsel bush, and blackberry (*Rubus* spp.) (PEF 2009a). Wetter areas support hydrophytic vegetation, including broadleaf cattail, pickerelweed, maidencane, and blue maidencane.

Pine Flatwoods (FLUCFCS 411)

Although once the most common upland vegetation in the area, few natural pine flatwoods remain on the LNP site, most having been harvested and replaced with planted pine stands (i.e., coniferous plantations). One small remnant area of pine flatwoods, representing about 3 ac or 0.1 percent of the LNP site, is present along the northern border of the site. Pine flatwoods are dominated by slash or longleaf pine with an understory of saw palmetto, wax myrtle, and gallberry. Spacing in the pine tree canopy is generally sparser and more random than in areas identified as coniferous plantations (FLUCFCS 441).

Shrub and Brushland (FLUCFCS 320)

The shrub and brushland cover type composes about 0.6 ac (less than 0.1 percent) of the LNP site acreage. Shrub and brushland is mostly dominated by saw palmetto intermixed with a wide variety of other woody scrub plant species, as well as various types of short herbs and grasses (FDOT 1999). The tree canopy component is typically sparse or absent.

Wetlands and Other Waters of the United States

Section 404 of the Clean Water Act requires permits for discharges into "waters of the United States." The term "waters of the United States" is defined in 33 CFR 328.3 and incorporates both wetlands and other surface-water features. A discussion of surface waters is presented in Section 2.4.2. Wetlands are defined as "those areas that are inundated or saturated by groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (33 CFR 328.3(b)). Proposed projects having wetland impacts in Florida require approvals from the USACE and the FDEP. The State wetland regulatory program for peninsular Florida (within which the LNP site falls) is implemented jointly by the FDEP and four water-management districts. The LNP site falls within the geographic territory of the SWFWMD.

PEF performed a wetland delineation for the LNP site following the 1987 Corps of Engineers Wetland Delineation Manual and State of Florida Unified Wetland Delineation Methodology (Fla. Admin. Code 62-340). The USACE requires the presence of three parameters in support of a wetlands determination: hydrophytic vegetation, hydric soils, and wetland hydrology. The FDEP uses similar criteria tailored to conditions commonly occurring in Florida. PEF is awaiting final approval of the delineation from the FDEP and USACE.

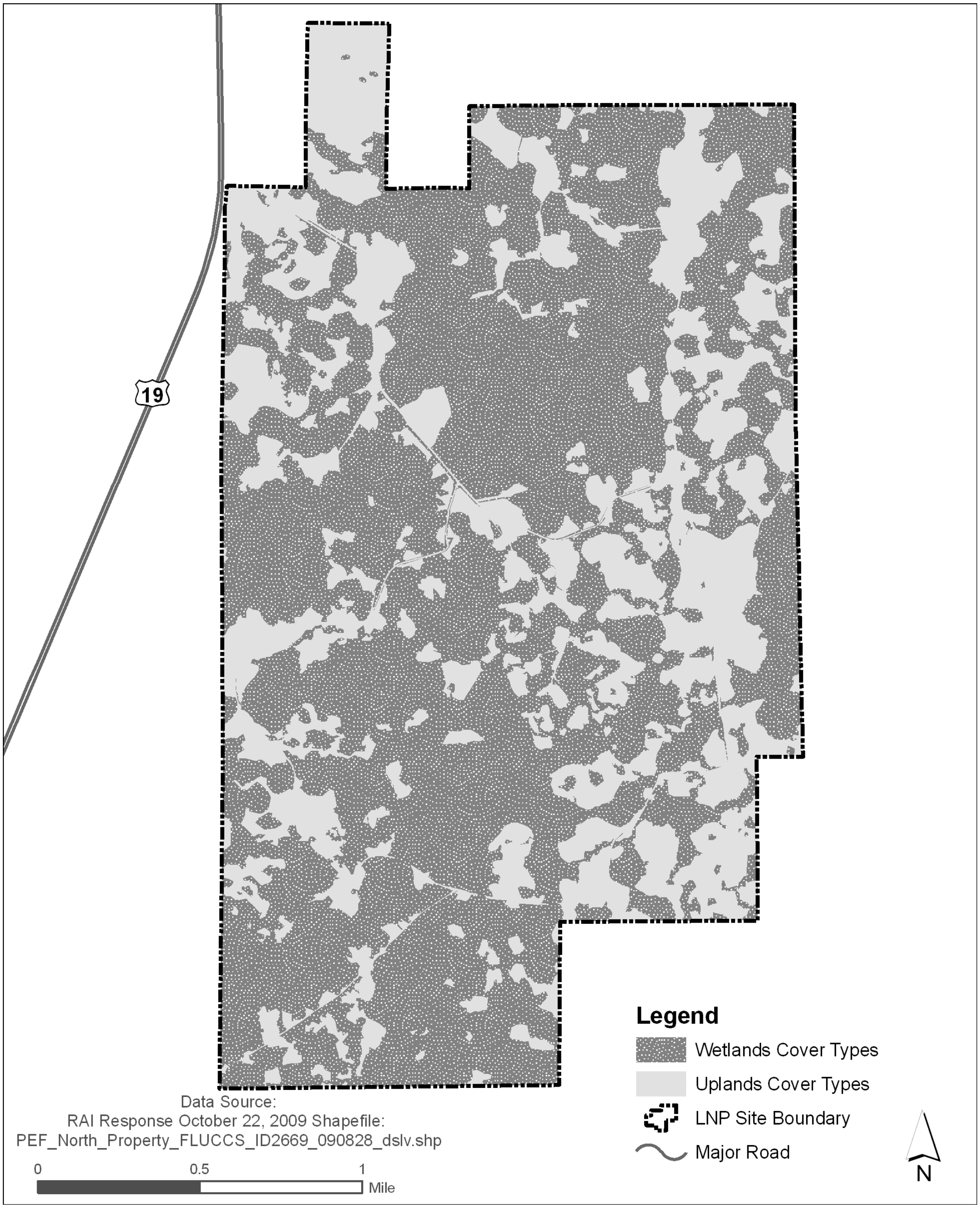
Most wetlands on the LNP site have been altered by years of intensive forest management that has included conversion of native habitats to planted pine plantations, extensive soil disturbance, and modifications of localized drainage patterns. The distribution of wetlands as delineated for the LNP site is presented in Figure 2-16 and the approximate acreage of wetlands by FLUCFCS cover types is provided in Table 2-6. Wetlands occur over about two-thirds (2001.5 ac) of the LNP site. The most common wetland community present is wet planted pine (FLUCFCS 629), which constitutes about 40.6 percent of onsite wetlands. These tree plantations mostly occupy wetter portions of former pine flatwoods and drier portions of former wetlands that have been substantially altered for commercial pine production. Forested wetland swamps (cypress – FLUCFCS 621; mixed wetland hardwoods – FLUCFCS 617, and wetland forest mixed – FLUCFCS 630) constitute another 43.8 percent of onsite wetlands. Forested swamps have been logged to varying degrees and consist of relatively intact forest stands interspersed with remnant stands made up of scattered trees. Treeless hydric savanna (FLUCFCS 646), representing about 13.7 percent of onsite wetlands, constitutes recently logged wetland forest stands not yet replanted. Freshwater marshes and wet prairie occupy less than 2 percent of the LNP site. These wetland communities are described above under Existing Cover Types (Habitats).

Wildlife

Wildlife populations and habitat on the LNP site have been altered by years of intensive forest management that has converted native forests to planted pine plantations. These actions have produced artificially simplified habitats lacking large mature trees, well-developed understory, and other habitat features (e.g., large snags, large woody debris) needed to support a wide assemblage of native wildlife. Nevertheless, the interspersion of wetlands, hardwoods, managed pine stands and recent clear-cuts provides habitat for many common wildlife species, especially those adapted to early successional stages and frequent landscape disturbance. Wildlife that require mature forest conditions and large blocks of unfragmented habitat are expected to be uncommon. While most mammals, amphibians, and reptiles present are year-round residents, many of the bird species represent individuals that may seasonally migrate to or through this region, including neotropical migrants. A branch of the eastern Atlantic Flyway crosses the region (FWS 2010a; Birdnature.com 2009).

PEF completed pedestrian surveys on the LNP site between October 2006 and November 2008 to characterize onsite habitats and document the presence of wildlife (PEF 2009h). Direct

1



2 **Figure 2-16**. Delineated Wetlands of the LNP Site (PEF 2009l)

Table 2-6. Area of Wetland Cover Types at the LNP Site

Wetland Cover Type	FLUCFCS Code[(a)]	Approximate Acres	Approximate Percent of LNP Wetlands
Wet planted pine	629	812.7	40.6
Cypress	621	402.6	20.1
Mixed wetland hardwoods	617	317.6	15.9
Treeless hydric savanna	646	274.4	13.7
Wetland forested mixed	630	156.4	7.8
Freshwater marshes	641	23.5	1.2
Wet prairie	643	14.3	0.7
Total wetlands		2001.5	100

Source: PEF 2009b.
(a) FLUCFCS = Florida Land Use, Covers and Forms Classification System.

observations of wildlife, as well as wildlife signs (e.g., scat, tracks), were recorded (PEF 2009a). Tables listing each wildlife species detected are provided in Appendix K. Wildlife species reported by the surveys are representative of those commonly found in west-central Florida. Wildlife species observed on the LNP site or expected to occur there based upon the presence of suitable habitat include 18 mammals, 72 birds, 25 reptiles, and 15 amphibians (PEF 2009h). Common mammals observed on the site include white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), feral hog (*Sus scrofa*), nine-banded armadillo (*Dasypus novemeinctus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and eastern cottontail (*Sylvilagus floridanus*). Numerous small mammals such as the cotton mouse (*Peromyscus gossypinus*), hispid cotton rat (*Sigmodon hispidus*), and eastern wood rat (*Neotoma floridana*) are expected onsite as well.

Birds observed on the site include blue jay (*Cyanocitta cristata*), northern cardinal (*Cardinalis cardinalis*), turkey vulture (*Cathartes aura*), eastern towhee (*Pipilo erythrophthalmus*), fish crow (*Corvus ossifragus*) and northern mockingbird (*Mimus polyglottos*), among many others. North American wood ducks (*Aix sponsa*) use the hardwood and cypress swamps, as do barred owls (*Strix varia*), red-shouldered hawks (*Buteo lineatus*), American woodcocks (*Scolopax minor*), and red-bellied woodpeckers (*Melanerpes carolinus*). Although several species of wading birds have been observed foraging in onsite wetlands, such as the great egret (*Ardea alba*) and white ibis (*Eudocimus albus*), no nesting colonies have been observed or are expected because of the absence of open water habitats preferred by these species. Numerous migratory bird species were observed on the LNP site, including American robin (*Turdus migratorius*), yellow-rumped warbler (*Dedroica coronata*), and cedar waxwing (*Bombycilla cedrorum*), among others.

Reptiles and amphibians observed on the LNP site include the black racer (*Coluber constrictor*), common garter snake (*Thamnophis sirtalis*), cottonmouth (*Agkistrodon piscivorus*), gopher tortoise (*Gopherus polyphemus*), Florida cooter (*Pseudemys floridana floridana*), southern leopard frog (*Rana utricularia*), and ground skink (*Scincella lateralis*). Depressional marshes on the LNP site provide breeding and foraging habitat for the southeastern five-lined skink (*Eumeces inexpectatus*), oak toad (*Bufo quercicus*), southern cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), and squirrel treefrog (*Hyla squirella*).

Invasive Species

Invasive species are defined in Executive Order 13112 as alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. They have the potential to alter native communities by displacing native species, changing plant community structure, or altering ecological functions. Invasive plants are generally not a problem on the LNP site at this time (PEF 2009a). However, small widely scattered patches of cogon grass (*Imperata cylindrica*), Japanese honeysuckle (*Lonicera japonica*), and Chinese privet (*Ligustrum sinense*) were observed, all of which can become highly invasive in disturbed environments where they can out-compete native vegetation.

Feral hogs, a non-native species descended from domestic farm animals, represent a major invasive mammal species on the LNP site. Feral hogs damage native vegetation by rooting and wallowing; eating reptiles, amphibians, and the eggs of ground-nesting birds; competing with native wildlife such as white-tailed deer and wild turkeys (*Meleagris gallopavo*) for acorns and other foods; and harboring diseases and parasites that may spread to native wildlife and people (Giuliano and Tanner 2005). Field inventories conducted by PEF from 2006 to 2008 documented the presence of a large population of feral hogs on the LNP site (PEF 2009a). Abundant damage to wetland communities was evident from rooting by feral hogs. PEF also observed the nine-banded armadillo, another non-native nuisance mammal, on the LNP site (PEF 2009a). Armadillos also may disrupt the soil and litter layers and prey upon smaller native animals.

2.4.1.2 Terrestrial Resources – Associated Offsite Facilities

This section describes terrestrial resources known to occur on or in the vicinity of the associated offsite facilities, including the transmission lines required to integrate the electrical power generated at the LNP into the Florida electrical grid system. The Florida Power Plant Siting Act (PPSA) provides for the certification of "corridors" within which linear facilities associated with an electrical power plant, such as proposed transmission lines, must be located. Once the final rights-of-way have been approved by the State and acquired, the boundaries of the corridors are revised to those of the acquired rights-of-way. As indicated in Section 2.2.2, the proposed new transmission lines would be built within a total of approximately 180 miles of corridor, including approximately 82 mi of corridor for new 500-kV transmission lines and approximately 98 miles of corridor new 230-kV transmission lines.

Pursuant to the PPSA, PEF (2009a, 2008a) has identified corridors for the linear facilities associated with the LNP. The heavy-haul road, makeup-water pipeline, and a portion of the blowdown pipeline would be built in a new common 0.25-mi-wide by 2-mi-long corridor that would extend from the southern boundary of the LNP site to the CFBC (Figure 2-3). The barge slip and CWIS would be built within this corridor as well. The remaining portion of the blowdown pipeline would be built in a new 0.25-mi-wide by 11-mi-long corridor that would extend from the CFBC to the CREC (Figure 3-7). PEF petitioned the State of Florida on April 29, 2010 for a modification to the currently certified corridor for the heavy-haul road, cooling-water makeup pipelines and the blowdown pipelines to be constructed between the LNP site and the CREC (Figure 3-7) (PEF 2009j). The purpose of the modification is to provide more flexibility in minimizing impacts on wetlands and other natural resources, especially salt marsh habitat, when siting these facilities, to reduce the use of State-owned lands along the CFBC, and to minimize disruption of recreational activities along the CFBC. Final right-of-way widths for each facility to be located within the corridor would remain the same.

A number of new transmission lines are proposed to connect the LNP switchyard to the PEF electrical grid (Figure 2-5). The proposed corridors within which the new lines would be built primarily lie within or adjacent to existing PEF high-voltage transmission lines. The transmission-line corridors range from 375 ft to 59 mi in length, and from approximately 300 ft to 1 mi wide (PEF 2008a; Golder Associates 2008). The variable corridor width is to allow for flexibility when determining the final right-of-way and for entering or exiting substations. Corridors collocated with existing PEF transmission-line corridors are generally narrower because the route ultimately selected is more certain. In total, about 180 mi of new transmission lines routed within about 148 mi of corridor (multiple lines occur in some corridors) would need to be built to incorporate the power generated by the proposed LNP into the Florida electrical grid system (Golder Associates 2008; CH2M Hill 2009c).

Four new 500-kV transmission lines would extend from the southern boundary of the LNP site to the first substation for each line. Proceeding south from the LNP site, all four transmission lines would be collocated in a 7-mi-long by 1-mi-wide common corridor. Two of these transmission lines would then connect to the proposed Citrus substation; one would connect to the proposed Central Florida South substation; and the other would connect to the CREC 500-kV switchyard (PEF 2008a, 2009a; Golder Associates 2008).

The proposed Citrus substation would be built in the common corridor; hence two of the transmission lines would terminate in the common corridor. Most of the 500-kV transmission-line segment extending east from the common corridor to the Central Florida South substation would be collocated with existing PEF transmission lines in a 1000-ft wide corridor. However, a new 1-mi wide corridor would be required for the final 13.5 mi. The 500-kV transmission line segment extending from the common corridor to the CREC switchyard would follow existing PEF transmission lines within a 1-mi-wide corridor (PEF 2008a, 2009a; Golder Associates 2008).

Additional transmission lines extending beyond the first substations would also be required to link the LNP to the electrical grid. Two 230-kV lines would extend from the proposed Citrus substation to the existing Crystal River East substation; a 230-kV line would extend from the CREC switchyard to the Brookridge substation; another 230-kV line would extend from the Brookridge substation to the Brooksville West substation; and the last 230-kV line would extend from the existing Kathleen substation to the Griffin substation and then beyond to the Lake Tarpon substation (PEF 2008a, 2009a; Golder Associates 2008). Two additional 69-kV lines would be required to support the LNP site and would connect to existing 69-kV lines from the western and the southern boundaries of the LNP site (PEF 2008a, 2009a; Golder Associates 2008).

Corridor segments required beyond the first substations include 38 mi mostly collocated with existing PEF transmission lines from the CREC switchyard to the existing Brookridge substation (corridor width of 1000 ft widens to 1 mi at endpoints). Another 3 mi of corridor (0.5 mi wide) would be collocated with existing PEF transmission line from the Brookridge substation to the Brooksville West substation. The transmission line extending 50 mi from the Kathleen substation to the Griffin substation, and west to the Lake Tarpon substation, would be collocated with existing PEF transmission lines in a corridor ranging from 300 to 1000 ft wide. Although a specific location for the proposed Citrus substation has not yet been finalized, connection to the existing Crystal River East substation would require new transmission lines sited within a corridor less than 2.7 mi long and 1 mi wide (PEF 2008a , 2009a; Golder Associates 2008).

PEF (2009a) has proposed to site a wellfield immediately south of the LNP site that would be used to supply general plant operations including service-water cooling, potable-water supply, raw water to the demineralizer, fire protection, and media filter backwash (see Figure 2-12). PEF estimates that plant operations would require an average total withdrawal of 1.58 Mgd of groundwater from the underlying Floridan aquifer. Much of this wellfield lies within the 1-mi-wide common corridor extending south of the LNP site, within which the four 500-kV transmission lines would be sited.

Existing Cover Types and Wetlands

Existing cover types present within corridors supporting associated offsite facilities were identified using FLUCFCS cover mapping obtained from the SWFWMD and the St. John's Water Management District (PEF 2009i). Pedestrian and vehicular field reconnaissance of accessible areas was conducted to verify and update the distribution of cover types, including wetlands (PEF 2008a, 2009h; Golder Associates 2008). After the final rights-of-way are selected and acquired, PEF will complete more detailed surveys pursuant to the PPSA to verify all cover types and delineate wetland boundaries (PEF 2009h). PEF expects to acquire rights-of-way as necessary to provide a typical width of 220 ft for the proposed 500-kV transmission lines and a typical width of 100 ft for the proposed 230-kV transmission lines (Golder Associates 2008).

Many areas within the corridors have been altered by prior land uses, such as residential development, forest management, agriculture, and utility development. Nevertheless, various upland, wetland, and aquatic habitats are present. The area of FLUCFCS cover types found within the corridors is summarized in Table 2-7, grouped by corridors that include all associated facilities that lie between the LNP site and the transmission-line first substations, and corridors inclusive of associated facilities that lie beyond the first substations. Refer to the FDOT (1999) FLUCFCS handbook for descriptions of these cover types.

Corridors up to the first substation would include the following associated facilities: barge slip; barge slip access road; heavy-haul road; makeup-water pipeline; CWIS; blowdown pipeline; groundwater wells to supply general plant operations; Citrus substation; Central Florida South substation; and the four 500-kV transmission lines connecting the LNP to the proposed Citrus substation, the proposed Central Florida South substation, and the existing CREC 500-kV switchyard. The vegetation cover types within corridors up to the first substation reflect the past level of human-induced change that has occurred across the landscape. Much of the historical vegetation on and around the corridors has been cleared or altered for land uses such as agriculture, residential development, forest management, utilities, and for roads and highways (see Table 2-7). The predominant upland cover types present include disturbed habitats such as cropland and pastureland, utilities, open land, low-density residential land and coniferous plantations. However, substantial blocks of relatively undisturbed mixed hardwood-conifer forest (FLUCFCS 434) are present, along with smaller stands of longleaf pine-xeric oak forest (FLUCFCS 412), pine flatwoods (FLUCFCS 411), and upland coniferous forest (FLUCFCS 410).

Almost 2800 ac of forested and herbaceous wetlands are present within corridors up to the first substation based upon the FLUCFCS cover types listed in Table 2-7. Of these, freshwater marshes (FLUCFCS 641), streams and lake swamps (FLUCFCS 615), and mixed forested wetlands (FLUCFCS 630) are the most prevalent. Wetlands range in quality from those exhibiting well-developed floristic and structural characteristics that provide valuable wildlife habitat, such as wetlands adjacent to the Withlacoochee River and Lake Rousseau, to freshwater marshes located within transmission-line corridors and pastures that have reduced functionality due to past and ongoing disturbance (e.g., tree canopy removal, drainage alteration, livestock grazing) (PEF 2008a). Other wetland habitats noted include (but are not limited to) cypress swamps (FLUCFCS 621), wet prairies (FLUCFCS 643), saltwater marshes (FLUCFCS 642), and intermittent ponds (FLUCFCS 653). Aquatic habitats present within corridors up to the first substation include the CFBC, the Withlacoochee River, small unnamed tributaries, reservoirs, small lakes, and bays/estuaries (as listed in Table 2-7).

Corridors beyond the first substation include the five 230-kV lines and the two 69-kV lines. The cover types present within these corridors also reflect a high level of past human-induced change, with much of the historical vegetation on and around the corridors cleared or altered for residential development, utilities, and agriculture (see Table 2-7). Upland cover types present in the corridors include disturbed habitats such as low-density residential, utilities, open land, and cropland and pastureland, as well as relatively undisturbed longleaf pine-xeric oak forest (FLUCFCS 412). Other upland cover types noted include (but are not limited to) small areas of mixed hardwood conifer forest (FLUCFCS 434), coniferous plantations (FLUCFCS 441), shrub and brushlands (FLUCFCS 320), and pine flatwoods (FLUCFCS 411). Predominant wetland cover types are represented by freshwater marsh (FLUCFCS 641), cypress swamps (FLUCFCS 621), stream and lake swamps (FLUCFCS 615), and mixed wetland forest (FLUCFCS 630) (Table 2-7). Freshwater marshes located within transmission-line corridors and pastures have reduced functionality due to past and ongoing disturbance (e.g., tree canopy removal, drainage alteration, livestock grazing) (PEF 2008a).

Wildlife

A wide variety of wildlife common to west-central Florida is expected to occur within corridors supporting associated offsite facilities. Wildlife diversity is expected to be greatest within corridors that support an interspersion of native upland, wetland, and aquatic habitats; and less in disturbed or developed lands. Habitats identified within corridors expected to provide higher value habitat for wildlife include mixed hardwood-conifer forest (FLUCFCS 434), longleaf pine-xeric oak forest (FLUCFCS 412), streams and lake swamps (FLUCFCS 615), mixed forested wetlands (FLUCFCS 630), salt marsh (FLUCFCS 642), wet prairie (FLUCFCS 643), pine flatwoods (FLUCFCS 411), cypress swamps (FLUCFCS 621), and upland conifer forests (FLUCFCS 410). Lower-quality wildlife habitat is represented by areas cleared for utilities, roads, agriculture and residential development; disturbed habitats such as pastureland, open land, other open land (rural) and coniferous plantations abundant along some corridors; and disturbed freshwater marshes located in utility corridors and on adjacent pastureland.

Limited surveys for wildlife have occurred within corridors supporting associated offsite facilities. Pedestrian and vehicular field reconnaissance of accessible areas was conducted to verify and update the distribution of cover types (PEF 2008a, 2009a, h; Golder Associates 2008). Information about wildlife and wildlife habitat was also collected during the surveys, with most effort directed toward important species. The corridor segment between the LNP site and the CFBC received the most investigation because much of this property has been purchased by PEF. The extent-of-ground reconnaissance was much lower for the long corridor segments that would support only transmission lines.

Table 2-7. FLUCFCS Cover Types Within the Associated Facilities Corridors

FLUCFCS Cover Type	FLUCFCS Code[(a)]	Corridors up to the First Transmission-Line Substation[(b)]		Corridors Beyond the First Transmission-Line Substation[(c)]	
		Acres	Percent	Acres	Percent
Urban and Built-Up					
Residential, low density	110	1592	6.5	2301	26.5
Rural residential	118	4	>0.1	0	0
Residential, medium density	120	24	0.1	388	4.5
Residential high density	130	56	0.2	137	1.6
Commercial and services	140	184	0.7	123	1.4
Industrial	150	103	0.4	35	0.4
Other light industrial	155	4	>0.1	0	0
Extractive	160	215	0.9	41	0.5
Holding ponds	166	1	>0.1	0	0
Institutional	170	28	0.1	16	0.2
Recreational	180	59	0.2	19	0.2
Golf courses	182		0	30	0.3
Open land	190	2144	8.7	647	7.4
Subtotal – Urban and Built-Up		4412	18.0	3737	43.0
Agricultural					
Cropland and pastureland	210	6514	26.5	754	8.7
Row crops	214	235	1.0	18	0.2
Field crops	215	6	>0.1	0	0
Tree crops	220	0	0	74	0.8
Feeding operations	230	0	0	14	0.2
Nurseries and vineyards	240	3.0	>0.1	17	0.2
Specialty farms	250	23	0.1	8	0.1
Other open lands – rural	260	1074	4.4	109	1.3
Total – Agricultural		7854	32.0	993	11.4

Table 2-7. (contd)

FLUCFCS Cover Type	FLUCFCS Code[(a)]	Corridors up to the First Transmission-Line Substation		Corridors Beyond the First Transmission-Line Substation[(c)]	
		Acres	Percent	Acres	Percent
Upland Nonforested					
Herbaceous upland nonforested	310	16	0.1	0	0
Shrub and brushland	320	254	1.0	147	1.7
Mixed rangeland	330	72	0.2	4	>0.1
Subtotal – Upland Nonforested		342	1.4	151	1.7
Upland Forested					
Upland coniferous forest	410	201	0.8	44	0.5
Pine flatwoods	411	202	0.8	75	0.9
Longleaf pine-xeric oak	412	828	3.4	1392	16.0
Upland hardwood forest	420	62	0.3	0	0
Hardwood-conifer mixed	434	2846[(e)]	11,6	255	2.9
Coniferous plantations[(d)]	441	1907	7.8	172	2.0
Subtotal – Upland Forested		6045	24.6	1938	22.3
Water					
Streams and waterways	510	244	1.0	4	>0.1
Lakes	520	57	0.2	9	0.1
Reservoirs	530	68	0.3	60	0.7
Bays and estuaries	540	3	>0.1	0	0
Subtotal – Water		334	1.4	73	0.8
Wetlands					
Stream and lake swamps (bottomland)	615	605	2.5	104	1.2
Mixed wetland hardwoods	617	33	0.1	0	0
Wetland coniferous forest	620	0	0	6	0.1
Cypress	621	194	0.8	120	1.4
Wetland forested mixed	630	503	2.09	96	1.1
Freshwater marshes	641	972	4.0	218	2.5
Saltwater marshes	642	100	0.4	0	0
Wet prairies	643	276	1.1	52	0.6

Table 2-7. (contd)

FLUCFCS Cover Type	FLUCFCS Code[(a)]	Corridors up to the First Transmission-Line Substation		Corridors Beyond the First Transmission-Line Substation[(c)]	
		Acres	Percent	Acres	Percent
Emergent aquatic vegetation	644	61	0.2	10	0.1
Mixed scrub-shrub wetland	646	11	>0.1	0	0
Intermittent ponds	653	34	0.1	16	0.2
Subtotal – Wetlands		2789	11.4	622	7.2
Barren Land					
Disturbed lands	740	114	0.5	24	0.3
Subtotal – Barren Land		114	0.5	24	0.3
Transportation, Communications & Utilities					
Transportation	810	583	2.4	46	0.5
Roads and highways	814	14	0.1	0	0
Utilities	830	2071	8.4	1113	12.8
Subtotal – Transportation, Communications & Utilities		2668	10.9	1159	13.3
Grand Total		24,558	100	8696	100

Source: PEF 2009b.
(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System (FDOT 1999).
(b) Also includes non-transmission line offsite facilities.
(c) Excludes acreage of FLUCFCS cover types already accounted for in corridors up to the first transmission-line substation because of corridor overlap.
(d) All tree plantations were assumed planted to pine and thus classified as coniferous plantations (FLUCFCS 441).
(e) Includes 6.7 ac of FLUCFCS 434 described by the St. John's Water Management District as Upland Mixed Coniferous/Hardwood.

Common mammals observed or expected to use the associated offsite facilities corridors include species such as the white-tailed deer, eastern cottontail, raccoon, opossum, gray squirrel (*Sciurus carolinensis*), southeastern pocket gopher (*Geomys pinetis*), feral hog, and nine-banded armadillo. Common birds expected include the black vulture (*Coragyps atratus*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk, wild turkey, great blue heron, American coot (*Fulvica americana*), American wood duck, common moorhen (*Gallinula chloropus*), great egret, red-winged blackbird (*Agelaius phoeniceus*), cattle egret (*Bubulcus ibis*), northern mockingbird, eastern phoebe (*Sayornis phoebe*), eastern meadowlark (*Sturnella magna*), and mourning dove (*Zenaida macroura*), among numerous others. Common reptiles and amphibians expected include the American alligator (*Alligator mississippiensis*), Florida box turtle (*Terrapene carolina bauri*), cottonmouth, black racer, yellow rat snake (*Elaphe obsolete quadrivittata*), green anole (*Anolis carolinensis*), ground skink, oak toad, and southern leopard frog, among others.

These determinations of wildlife presence are based upon wildlife-habitat relationships in central Florida and the onsite surveys (PEF 2008a, 2009a, h; Golder Associates 2008). Because landscapes associated with the corridors are generally similar in terms of common habitats and levels of disturbance, these species are expected to be equally common in corridors up to the first substation and in corridors beyond the first substation.

2.4.1.3 Important Terrestrial Species and Habitats – Site and Vicinity

The NRC defines important species as rare, having economic value, being relied on by a valuable species, playing an ecological role, or being ecologically sensitive (NRC 2000). Rare species include the following: those listed as threatened or endangered by the U.S. Fish and Wildlife Service (FWS); proposed for listing as threatened or endangered; published in the *Federal Register* as a candidate for listing; or listed as threatened, endangered, or another species of concern status by the State in which the proposed facility is located. Importance is also bestowed on species that are either commercially or recreationally valuable as well as those species that are essential to the maintenance and survival of valuable species. Species that occupy a role critical to the function of the local ecosystem are also considered important, in addition to species that may serve as biological indicators for environmental change.

Conservation set-aside lands (sanctuaries, refuges, or preserves), habitats designated by State and/or Federal governments to receive protection priority (unique or rare), wetlands/floodplains, and critical habitat designated as such for species Federally listed as threatened or endangered are all considered “important habitats” (NRC 2000). Although the LNP site does not contain any critical habitat for threatened or endangered species, there are State sanctuaries, preserves, and other lands in the vicinity of the site that receive priority protections. In addition, Federal and State jurisdictional wetlands occur both on the LNP site and in the site vicinity.

To identify important species and habitats that may occur on or near the LNP site, PEF reviewed applicable agency websites, agency databases, and relevant literature pertaining to the site (PEF 2009a). PEF contractors completed pedestrian surveys of the LNP site between September 2006 and November 2008 to characterize onsite habitats, document species presence, and identify areas that may support important terrestrial species and habitats (PEF 2009h). Wetlands on the LNP site were delineated, and subsequently verified by the USACE. This section summarizes the information gathered about important terrestrial species and habitats that may occur in the vicinity of the LNP site.

Federally and State-Listed Terrestrial Species

The Endangered Species Act (ESA) of 1973, as amended (16 USC 1531), was passed by Congress for the purpose of conserving habitats upon which endangered and threatened species depend, and for conservation and recovery of listed species. The ESA is administered by the U.S. Department of the Interior's FWS and the Commerce Department's National Marine Fisheries Service (NMFS). Under the ESA, a Federally endangered species is defined as one in danger of extinction throughout all or a significant portion of its range. A Federally threatened species is defined as one likely to become endangered in the foreseeable future throughout all or a significant portion its range.

The State of Florida also lists endangered, threatened and species of special concern (SSC) under Florida Administrative Code 68A-27 for animal species. These regulations are implemented by the Florida Fish and Wildlife Conservation Commission (FFWCC). Further, the Florida Department of Agriculture and Consumer Services (FDACS) lists plants on the Regulated Plant Index as endangered, threatened, or commercially exploited (Fla. Admin. Code 5B-40). FDACS regulates the unlawful harvesting of native flora without permission from the landowner, but does not regulate removal of listed plants for development or other land-alteration activities on privately owned land (35 Fla. Stat. 581). Furthermore, the LNP project would be exempt from restrictions on native flora disturbances during clearing under (8)(c) of Florida Statutes 581.185 (Hildebrandt 2010).

Endangered, threatened, and other special-status Federal and State species that may occur on or near the LNP site are presented in Table 2-8, which includes Federal species with recorded occurrences in Levy and Citrus Counties, as presented on the FWS website (FWS 2009a). The FFWCC provided a list of sensitive State species that could occur on the site as part of the FDEP's coordinated review of the Site Certification Application submitted by PEF for the proposed LNP (FDEP 2010a).

The Florida Natural Areas Inventory (FNAI) and FFWCC compile and maintain comprehensive databases of biological resources in Florida, including documented occurrences of both Federally and State-listed protected plant and animal species. The FNAI Occurrence Report (PEF 2008a) and FFWCC Environmental Resource Analysis (FFWCC 2009a) generated for the LNP site identified several protected species (e.g., gopher tortoise, eastern indigo snake

Table 2-8. Federally and State-Listed Terrestrial Species Potentially Occurring on the LNP Site and Associated Facilities

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
			Mammals			
Florida mouse *Podomys floridanus*	N	SSC	Xeric upland communities with sandy soils, including scrub, sandhill, and ruderal sites	Possible	Possible	Possible
Florida saltmarsh vole *Microtus pennsylvanicus dukecampbelli*	E	E	Saltgrass meadows adjacent to black needlerush in Levy County	Unlikely	Possible	Unlikely
Homosassa shrew *Sorex longirostris eionis*	N	SSC	Forested wetlands, hammocks, pine flatwoods, pine sandhill, palmetto thickets and clearcuts	Possible	Possible	Possible
Sherman's fox squirrel *Sciurus niger shermani*	N	SSC	Sandhills, pine flatwoods, pastures, and other open, ruderal habitats with scattered pines and oaks	Unlikely	Observed	Observed
Florida panther *Puma concolor coryi*	E	E	Extensive blocks of forestland and large wetlands	Unlikely	Unlikely	Possible
Florida black bear *Ursus americanus floridanus*	N	T	Large areas of forested uplands and forested wetlands	Possible	Possible	Observed
			Birds			
Scott's seaside sparrow *Ammodramus maritimus*	N	SSC	Tidal marshes	Unlikely	Possible	Possible
Florida scrub jay *Aphelocoma coerulescens*	T	T	Low-growing oak scrub habitat	Unlikely	Observed	Possible
Limpkin *Aramus guarauna*	N	SSC	Mangroves, freshwater marshes, swamps, springs, spring runs, pond, river, and lake margins	Possible	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[(a)]	State Status[(a)]	Suitable Habitat	Likelihood of Occurrence[(b)]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Florida burrowing owl *Athene cunicularia floridana*	N	SSC	Dry, sparsely vegetated, sandy ground, including dry prairie, sandhill, and disturbed areas (e.g., pastures, parks, school grounds, road right-of-ways)	Unlikely	Possible	Possible
Piping plover *Charadrius melodus*	T	T	Tidal mudflats	Unlikely	Unlikely	Possible
Marian's marsh wren *Cistothorus palustris marianae*	N	SSC	Tidal marshes	Unlikely	Possible	Possible
Little blue heron *Egretta caerulea*	N	SSC	Freshwater lakes, marshes, swamps, and streams; roosts in cypress trees	Possible	Observed	Possible
Snowy egret *Egretta thula*	N	SSC	Freshwater and coastal wetlands, streams, lakes, and swamps, manmade impoundments, ditches	Possible	Observed	Possible
Tricolored heron *Egretta tricolor*	N	SSC	Wetlands, ditches, pond and lake edges, coastal areas	Possible	Observed	Possible
White Ibis *Eudocimus albus*	N	SSC	Freshwater and brackish marshes, salt flats, forested wetlands, wet prairies, swales, manmade ditches	Observed	Observed	Possible
Southeastern American kestrel *Falco sparverius paulus*	N	T	Open pine habitats, woodland edges, prairies, and pastures	Possible	Possible	Observed
Florida sandhill crane *Grus canadensis pratensis*	N	T	Prairies, freshwater marshes, and pastures	Unlikely	Possible	Possible
American oystercatcher *Haematopus palliatus*	N	SSC	Mudflats	Unlikely	Possible	Possible
Wood stork *Mycteria americana*	E	E	Cypress strands and domes, mixed hardwood swamps	Observed	Observed	Observed

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Brown pelican *Pelecanus occidentalis*	N	SSC	Coastal waters, bays and estuaries; nesting on small islands in bays and estuaries	Unlikely	Possible	Possible
Red-cockaded woodpecker *Picoides borealis*	E	SSC	Mature longleaf and slash pine forests; present in the Goethe State Forest	Unlikely	Possible	Possible
Roseate spoonbill *Platalea ajaja*	N	SSC	Tidal flats, coastal and freshwater marshes	Unlikely	Possible	Possible
Black skimmer *Rynchops niger*	N	SSC	Coastal waters; also large lakes, phosphate pits, and flooded agricultural fields	Unlikely	Possible	Possible
Least tern *Sterna antillarum*	N	T	Coastal areas, beaches, lagoons, bays, estuaries	Unlikely	Possible	Possible
			Reptiles			
American alligator *Alligator mississippiensis*	T	SSC	Most permanent bodies of fresh water, including marshes, swamps, lakes, and rivers	Observed	Observed	Possible
Eastern indigo snake *Drymarchon couperi*	T	T	Broad range of habitats, from scrub and sandhill to wet prairies and mangrove swamps; often commensal with gopher tortoises	Possible	Observed	Possible
Gopher tortoise *Gopherus polyphemus*	N	T	Dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; also pastures, old fields	Observed	Observed	Observed
Sand skink *Neoseps reynoldsi*	T	T	Rosemary scrub, sand pine and oak scrubs, scrubby flatwoods, turkey oak ridges within scrub, citrus groves occupying former scrub	Unlikely	Possible	Unlikely

Table 2-8. (contd)

				Likelihood of Occurrence[(b)]		
					Associated Facilities	
Common Name/ Scientific Name	**Federal Status[(a)]**	**State Status[(a)]**	**Suitable Habitat**	**LNP Site**	**Up to First Substation**	**Beyond First Substation**
Florida pine snake *Pituophis melanoleucus mugitus*	N	SSC	Sandhills, old fields and pastures, sand pine scrub, scrubby flatwoods; often commensal with gopher tortoises and pocket gophers	Possible	Possible	Possible
Short-tailed snake *Stilosoma extenuatum*	N	T	Sandhills, xeric hammock, and sand pine scrub	Possible	Possible	Possible
			Amphibians			
Gopher frog *Rana capito*	N	SSC	Sandhills and scrub with isolated wetlands or large ponds; commensal with gopher tortoises.	Possible	Possible	Possible
			Plants			
Brittle maidenhair fern (*Adiantum tenerum*)	N	E	Limestone outcrops, grottoes, sinkholes	Unlikely	Possible	Possible
Incised groove-bur (*Agrimonia incise*)	N	E	Sandhills and scrub	Unlikely	Possible	Possible
Variable-leaved Indian-plantain (*Arnoglossum diversifolium*)	N	T	Freshwater and riparian habitats	Possible	Possible	Possible
Golden leather fern (*Acrostichum aureum*)	N	T	Brackish and freshwater marshes	Possible	Possible	Possible
Pine-woods bluestem (*Andropogon arctatus*)	N	T	Wet pine flatwoods	Possible	Possible	Possible
Auricled spleenwort (*Asplenium erosum*)	N	E	Pinelands	Possible	Possible	Possible
Dwarf spleenwort (*Asplenium pumilum*)	N	E	Pinelands	Possible	Possible	Possible
Modest spleenwort (*Asplenium*	N	E	Rockland hammocks, limestone outcrops, grottoes, sinkholes	Unlikely	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[(a)]	State Status[(a)]	Suitable Habitat	Likelihood of Occurrence[(b)] LNP Site	Associated Facilities: Up to First Substation	Associated Facilities: Beyond First Substation
verecundum)						
Nuttall's rayless goldenrod (*Bigelowia nuttallii*)	N	E	Sand pine scrub in Pinellas County	Unlikely	Possible	Possible
Sinkhole fern (*Blechnum occidentale*)	N	E	Moist woodlands, hammocks, rocky creek banks, woodlands with open shade	Possible	Possible	Possible
Florida bonamia (*Bonamia grandiflora*)	T	E	Openings or disturbed areas in white sand scrub	Unlikely	Possible	Possible
Ashe's savory (*Calamintha ashei*)	N	T	Sandhills and scrub	Possible	Possible	Possible
Manyflowered grasspink (*Calopogon multiflorus*)	N	E	Dry to moist flatwoods with longleaf pine, wiregrass, saw palmetto	Unlikely	Possible	Possible
Brooksville bellflower (*Campanula robinsiae*)	E	E	Wet, grassy slopes and drying pond edges in vicinity of Chinsegut Hill in Hernando County	Unlikely	Unlikely	Possible
Chapman's sedge (*Carex chapmanii)*	N	E	Grasslands, pinelands	Possible	Possible	Possible
Sand butterfly pea (*Centrosema arenicola*)	N	E	Sandhill, scrubby flatwoods, dry upland woods	Possible	Possible	Possible
Sanddune spurge (*Chamaesyce cumulicola)*	N	E	Coastal scrub and stabilized dunes	Unlikely	Possible	Possible
Southern lip fern (*Cheilanthes microphylla*)	N	E	Coastal habitats	Unlikely	Possible	Possible
Pygmy fringe tree (*Chionanthus pygmaeus*)	E	E	Scrub, sandhill, and xeric hammock	Unlikely	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b] LNP Site	Associated Facilities: Up to First Substation	Associated Facilities: Beyond First Substation
Florida goldenaster (*Chrysopsis floridana*)	E	E	Sand pine scrub, sand ridges of excessively well-drained, fine sands, railroad and highway corridors	Unlikely	Unlikely	Possible
Piedmont jointgrass (*Coelorachis tuberculosa*)	N	T	Freshwater habitats	Possible	Possible	Possible
Longspurred mint (*Dicerandra cornutissima*)	E	E	Sand pine and oak scrub	Unlikely	Observed	Unlikely
Spoon-leavf sundew (*Drosera intermedia*)	N	T	Freshwater habitats	Possible	Possible	Possible
Sanibel lovegrass (*Eragrostis pectinacea* var. *tracyi*)	N	E	Disturbed beach dunes, maritime hammocks, coastal strands, coastal grasslands, old fields, clearings, and other disturbed sites	Unlikely	Possible	Possible
Scrub wild buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*)	T	E	Sandhill, oak-hickory scrub	Unlikely	Possible	Possible
Wood spurge (*Euphorbia commutata*)	N	E	Riparian habitats	Possible	Possible	Possible
Godfrey's swampprivet (*Forestiera godfreyi)*	N	E	Upland hardwood forests with limestone at or near the surface, often on slopes above lakes and rivers	Possible	Possible	Possible
Coastal mock vervain (*Glandularia maritima*)	N	E	Back dunes, dune swales, coastal hammocks	Possible	Observed	Possible
Tampa mock vervain (*Glandularia tampensis*)	N	E	Live oak–cabbage palm hammocks and pine-palmetto flatwoods	Possible	Possible	Possible
Wild cotton (*Gossypium hirsutum*)	N	E	Coastal strands and disturbed areas	Unlikely	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[(a)]	State Status[(a)]	Suitable Habitat	Likelihood of Occurrence[(b)]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Hartwrightia (*Hartwrightia floridana*)	N	T	Seepage slopes, edges of baygalls and springheads, wet prairies, flatwoods	Possible	Possible	Possible
Florida hasteola (*Hasteola robertiorum*)	N	E	Saturated, peaty soils of river and creek floodplain swamps; hydric hammocks with cabbage palm, cypress, or hardwood canopy	Possible	Possible	Possible
Edison's ascyrum (*Hypericum edisonianum*)	N	E	Depressions in scrub, cut-throat seeps, flatwoods ponds, lake margins, wet prairie	Possible	Possible	Possible
Star anise (*Illicium parviflorum*)	N	E	Banks of spring-run or seepage streams, bottomland forest, hydric	Possible	Possible	Possible
Cooley's water-willow (*Justicia cooleyi*)	E	E	Mesic hardwood hammocks over limestone	Unlikely	Possible	Possible
Nodding pinweed (*Lechea cernua*)	N	T	Usually ancient dunes with evergreen scrub oaks, mature scattered pine or oak forest	Possible	Possible	Possible
Pine pinweed (*Lechea divaricata)*	N	E	Scrub and scrubby flatwoods	Unlikely	Possible	Possible
Corkwood (*Leitneria floridana)*	N	T	Edges of marshy openings and along small drainages in coastal hydric hammocks; fresh or tidal marshes	Possible	Possible	Possible
Pondspice (*Litsea aestivalis)*	N	E	Edges of baygalls, flatwoods ponds, and cypress domes. May form thickets around edges of ponds	Possible	Possible	Possible
Cardinal-flower (*Lobelia cardinalis*)	N	T	moist meadows, bogs and along stream banks	Possible	Possible	Possible
Florida spiny pod (*Matelea floridana)*	N	E	Pinelands and temperate forests	Possible	Possible	Possible
Pinesap (*Monotropa hypopithys)*	N	E	Temperate forests	Possible	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Pygmy pipes (*Monotropsis reynoldsiae*)	N	E	Upland mixed hardwood forest, mesic and xeric hammock, sand pine and oak scrub	Possible	Possible	Possible
Narrowleaf naiads (*Najas filifolia*)	N	T	Freshwater habitats	Possible	Possible	Possible
Celestial lily (*Nemastylis floridana*)	N	E	Freshwater habitats	Possible	Possible	Possible
Florida beargrass (*Nolina atopocarpa*)	N	T	Grasslands, pinelands	Possible	Possible	Possible
Britton's beargrass (*Nolina brittoniana*)	E	E	Scrub, sandhill, scrubby flatwoods, and xeric hammock	Unlikely	Possible	Possible
Hand fern (*Ophioglossum palmatum*)	N	E	Old leaf bases of cabbage palms in maritime and wet hammocks	Possible	Possible	Possible
Large-leaved grass-of-parnassus (*Parnassia grandifolia*)	N	E	Seepage slopes, wet prairies, edges of cypress strands	Possible	Possible	Possible
Widespread polypody (*Pecluma dispersa*)	N	E	Tree branches and limestone outcrops in dry hammocks	Possible	Possible	Possible
Plume polypody (*Pecluma plumula*)	N	E	Tree branches or limestone in hammocks, wet woods, and limesinks	Possible	Possible	Possible
Swamp plume polypody (*Pecluma ptilodon*)	N	E	Rockland hammocks, strand swamps, wet woods	Possible	Possible	Possible
Terrestrial peperomia (*Peperomia humilis*)	N	E	Shell mounds and limestone outcrops in mesic hammocks, coastal berms, cypress swamps	Unlikely	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Pinewood dainties (*Phyllanthus leibmannianus ssp. platylepis)*	N	E	Hydric hammocks, floodplain and bottomland forests	Possible	Observed	Possible
Yellow fringeless orchid (*Platanthera integra*)	N	E	Wet pine flatwoods, wet prairies, depressions within pinelands	Possible	Possible	Possible
Lewton's polygala (*Polygala lewtonii*)	E	E	Oak scrub, sandhill	Unlikely	Possible	Possible
Small's jointweed (*Polygonella myriophylla*)	E	E	Open, sandy areas within scrub	Unlikely	Possible	Possible
Scrub plum (*Prunus geniculata*)	E	E	Sandhill and oak scrub	Unlikely	Possible	Possible
Giant orchid (*Pteroglossaspis ecristata)*	N	T	Sandhill, scrub, pine flatwoods, pine rocklands	Unlikely	Possible	Observed
Florida mountain-mint (*Pycnanthemum floridanum*)	N	T	Pinelands, sandhills, scrub	Possible	Possible	Possible
Browneyed Susan (*Rudbeckia triloba* var. *pinnatiloba*)	N	E	Freshwater habitats, grasslands, pinelands	Possible	Possible	Possible
Florida willow (*Salix floridana*)	N	E	Springheads, edges of spring runs, hydric hammocks, floodplains	Possible	Possible	Possible
Scrub bluestem (*Schizachyrium niveum*)	N	E	Rosemary, sand pine, and oak scrub	Possible	Possible	Possible
Silver buckthorn (*Sideroxylon alachuense*)	N	E	Upland hardwood forests around limesinks	Possible	Possible	Possible
Buckthorn (*Sideroxylon lycioides*)	N	E	Wooded slopes, floodplains, and bluffs	Possible	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Pinkroot (*Spigelia loganioides)*	N	E	Floodplain forests, upland and hydric hardwood hammocks over limestone	Possible	Possible	Possible
Green ladies'-tresses (*Spiranthes polyantha)*	N	E	Rock outcrops in mesic hammock, rockland hammock, maritime hammock	Unlikely	Possible	Possible
Scrub stylisma (*Stylisma abdita*)	N	E	Pinelands, sandhills, scrub	Possible	Possible	Possible
Creeping maiden fern (*Thelypteris reptans*)	N	E	Limestone grottoes and sinkholes	Unlikely	Possible	Possible
Toothed maiden fern (*Thelypteris serrata*)	N	E	Cypress swamps, sloughs, floodplains	Possible	Possible	Possible
Florida filmy fern (*Trichomanes punctatum* ssp. *floridanum)*	N	E	Rock outcrops	Unlikely	Possible	Possible
Broad-leaved nodding-caps (*Triphora amazonica*)	N	E	Rich damp hardwood hammocks	Possible	Possible	Possible
Craighead's nodding-caps (*Triphora craigheadii)*	N	E	Mesic hardwood hammocks	Possible	Possible	Possible

Table 2-8. (contd)

Common Name/ Scientific Name	Federal Status[a]	State Status[a]	Suitable Habitat	Likelihood of Occurrence[b]		
					Associated Facilities	
				LNP Site	Up to First Substation	Beyond First Substation
Ocala vetch (*Vicia ocalensis*)	N	E	Open, wet thickets along margins of spring runs and streams	Possible	Possible	Possible
Wide-leaf warea (*Warea amplexifolia*)	E	E	Sandhill with longleaf pine and wiregrass	Unlikely	Possible	Possible
Carter's mustard (*Warea carteri*)	E	E	Sandhill, scrubby flatwoods, scrub	Unlikely	Possible	Possible

Sources: PEF 2008a, 2009a, h; Golder Associates 2008; FFWCC 2009a.

(a) E = Endangered; T = Threatened; N = Not Listed; SSC = Florida Species of Special Concern. Florida does not assign plants species to the SSC category.

(b) Observed = documented during LNP project surveys (PEF 2008a, 2009a, h; Golder Associates 2008), or known from a State or Federal database record; Possible = potentially present as based upon (1) nearby database records or observations, or (2) the presence of suitable habitat within the known range for that species; Unlikely = not expected to be present because (1) the area is outside the known range for that species, (2) suitable habitat is not present, or (3) protocol surveys did not detect the species.

[*Drymarchon corais couperi*], and Florida scrub jay [*Aphelocoma coerulescens*]) known to occur in the vicinity of the LNP site. Although there were no documented occurrences of protected species on the LNP site, both reports identified the site as having the potential to provide habitat for several protected species. Pedestrian surveys on the LNP site completed by PEF (2009a, h) provided additional information about the presence of protected plants and animals and/or their habitats on the LNP site. The only targeted surveys completed onsite for protected species were for the gopher tortoise (PEF 2009a). A condition of certification by the FDEP would require protocol surveys for all State-listed species that may occur on the LNP site and associated facilities prior to vegetation “clearing and construction” (FDEP 2010a).

The review team (composed of NRC staff, its contractor staff, and USACE staff) has prepared a biological assessment that addresses Federally listed threatened and endangered plant and animal species that potentially could occur on or near the LNP site. Life-history attributes of federally-listed species are provided in more detail in the biological assessment. The biological assessment is provided in Appendix F.

A brief discussion of Federal and some of the State-protected terrestrial species that could occur in the LNP site vicinity is provided below.

<u>Gopher Tortoise</u> (*Gopherus polyphemus*)
Federal – Not Listed; Florida – Threatened

Gopher tortoises typically occur in dry upland habitats such as sandhills (generally corresponding to FLUCFCS 412), scrub (generally corresponding to FLUCFCS 413 and 421), xeric oak hammock (generally corresponding to FLUCFCS 427), and dry pine flatwoods (generally corresponding to FLUCFCS 411), as well as disturbed sites such as pastures, old fields, and road shoulders (FNAI 2009). The burrows they excavate serve as a refuge for other commensal species such as the eastern indigo snake, gopher frog (*Rana capito*), Florida mouse (*Podomys floridanus*), and Florida pine snake (*Pituophis melanoleucus mugitus*) (FNAI 2009).

PEF conducted targeted surveys for gopher tortoises at the LNP site and for the associated facilities immediately south of the LNP site (PEF 2009a). In total, 58 gopher tortoise burrows were documented in both areas. Most burrows were located in areas with relatively open canopy and shrub layers, along existing roads, edges of wetlands, and in spoil areas. The shallow groundwater depth on the LNP site acts to limit the distribution and density of gopher tortoise burrows. Their occurrence increased toward the south, immediately north of CR-40 and along the spoil areas of the CFBC.

Eastern Indigo Snake (*Drymarchon corais couperi*)
Federal – Threatened; Florida – Threatened

The eastern indigo snake occupies a broad range of habitats, varying from scrub and sandhill habitats (generally corresponding to FLUCFCS 412, 413, and 421) to moister communities such as wet prairies (FLUCFCS 643) and swamps (FNAI 2009). It requires large tracts of habitat to survive. It often winters in gopher tortoise burrows, especially in northern Florida where temperatures are cooler. Although the eastern indigo snake was not observed during field surveys of the LNP site (PEF 2009a, h), the species has been documented in the site vicinity (PEF 2008a; FFWCC 2009a). The closest known record for this species is about 2 mi west of the LNP site (FNAI 2009). There is potential for this species to occur on the LNP site due to the presence of suitable habitat and gopher tortoises.

Florida Pine Snake (*Pituophis melanoleucus mugitus*)
Federal – Not Listed; Florida – Species of Special Concern

The Florida pine snake burrows in dry sandy soils in habitats with relatively open canopies, especially within xeric sandhills (generally corresponding to FLUCFCS 412) or former sandhill communities (presently occurring as old fields and pastures), as well as sand pine scrub (FLUCFCS 413) and scrubby flatwoods (generally corresponding to FLUCFCS 423 and 432) (FNAI 2009). It spends most of its time below ground, with occasional surface activity from spring through fall. The species is often associated with the burrow systems of gopher tortoises and pocket gophers (*Geomys pinetis*). Most dry upland habitats on the LNP site have been converted to coniferous pine plantations; reducing habitat suitability, but gopher tortoises have been documented onsite. Although the Florida pine snake was not identified during field surveys of the LNP site (PEF 2009a, h), the species has been documented in the vicinity (FFWCC 2009a). Consequently, there is a potential for this secretive species to occur on the LNP site.

Short-Tailed Snake (*Stilosoma extenuatum*)
Federal – Not Listed; Florida – Threatened

The short-tailed snake occupies dry upland habitats, principally sandhill (generally corresponding to FLUCFCS 412), xeric hammock (generally corresponding to FLUCFCS 427 and 4362), and sand pine scrub (FLUCFCS 413) (FNAI 2009). This species is a secretive burrower only rarely seen above ground or under cover objects. Most above-ground activity occurs in October and November, with a few sightings in March and April. Dry upland habitats on the LNP site have been altered by forest management, reducing habitat suitability for the short-tailed snake. No short-tailed snakes were identified by PEF (2009a, h) during field surveys of the LNP site, but the species has been documented in the vicinity (FFWCC 2009a). Consequently, there is a potential for this species to occur on the LNP site.

American Alligator (*Alligator mississippiensis*)
Federal – Threatened by Similarity of Appearance; Florida – Species of Special Concern

The American alligator is classified as a Federal threatened species and a Florida species of special concern because of its similarity in appearance to the endangered American crocodile (*Crocodylus acutus*) (FNAI 2009). The range of the American crocodile, however, is limited to coastal estuarine marshes and tidal swamps in south Florida. The American alligator is a common inhabitant of most freshwater habitats in Florida, including marshes and swamps such as those found on the LNP site. One juvenile American alligator was observed on the LNP site during field surveys conducted by PEF (2009a, h).

Gopher Frog (*Rana capito*)
Federal – Not Listed; Florida – Species of Special Concern

The gopher frog inhabits dry sandy uplands, primarily sandhill and scrub (generally corresponding to FLUCFCS 412, 413, and 421) that includes isolated wetlands or large ponds within about 1 mi of the upland (FNAI 2009). Breeding occurs chiefly in seasonally flooded, temporary ponds, but also in some permanent waters. Gopher frogs are generally nocturnal, normally spending daytime in stumpholes, tunnels, or burrows, especially those of gopher tortoise. Although the gopher frog was not identified during field surveys of the LNP site (PEF 2009a, h), the species is known in the site vicinity (PEF 2008a; FFWCC 2009a). The closest record for this species is about a-half mile east of the site (PEF 2008a). Although the alteration of dry upland habitats on the LNP site by forest management has reduced habitat suitability, the presence of gopher tortoises indicates a potential for this species to occur.

Southeastern American Kestrel (*Falco sparverius paulus*)
Federal – Not Listed; Florida – Threatened

The southeastern American kestrel is found in open pine habitats, woodland edges, prairies, and pastures throughout much of Florida (FNAI 2009). Only the resident (i.e., year-round) subspecies that breeds in Florida is listed as threatened; northern migrant American kestrels that winter in Florida (generally from September through March) are not listed. Nesting usually occurs in cavities excavated by various woodpeckers in large snags (pines and occasionally oaks) or utility poles with unobstructed views of the surrounding landscape (FNAI 2009). Nest-box programs have been used to augment populations in many areas.

The southeastern American kestrel may breed on the LNP site if suitable nest cavities are present. The conversion of native habitats to coniferous pine plantations has degraded suitable nesting habitat for kestrels. Nevertheless, PEF (2009a, h) has observed American kestrels on the LNP site in all seasons, including summer. Any American kestrel found during the breeding season (April through early September) should be treated as the listed subspecies.

<u>Red-Cockaded Woodpecker</u> (*Picoides borealis*)
Federal – Endangered; Florida – Species of Special Concern

The red-cockaded woodpecker is endemic to open, mature, and old growth pine ecosystems in the southeastern United States (FWS 2003). The species requires open pine woodlands and savannahs with large old pines for nesting, roosting, and foraging. In northern and central Florida, it favors mature longleaf pine flatwoods (generally corresponding to FLUCFCS 411 and 412) (FNAI 2009). This cooperative breeding species excavates nest cavities in large, live older pines from stands containing little to no hardwood in the midstory and overstory. Home range size varies between 100 and 400 acres per family group, depending upon quality of the foraging habitat (FWS 2003). Insects comprise more than 75 percent of the adult diet, with fruits and seeds making up the remainder (FWS 2003). Suitable foraging habitat consists of mature pines with an open canopy, low densities of small pines, little or no hardwood or pine midstory, few or no overstory hardwoods, and abundant native bunchgrass and forb groundcovers (FWS 2003). Cypress trees account for about 10 percent of foraging time in south-central Florida, and hardwoods represent a minor (0–5 percent) foraging substrate.

No red-cockaded woodpeckers have been observed on the LNP site (PEF 2009a, h). The young, heavily managed pine plantations that characterize uplands on the site do not provide suitable nesting or foraging habitat. A large population of red-cockaded woodpeckers does occur in the Goethe State Forest, which is directly north and northwest of the LNP site (FDACS 2009). The Florida Division of Forestry actively manages habitat on the Goethe State Forest and supplements the population by translocating birds from other areas to improve population viability (Petersen 2010). An abandoned red-cockaded woodpecker cluster (i.e., an aggregation of cavity trees used by a family group of red-cockaded woodpeckers) is located immediately north of the LNP site on the Goethe State Forest. Reoccupation of this cluster by red-cockaded woodpeckers is unlikely at this time because there are no current plans to restore habitat there (Petersen 2010). Several active clusters lie between 1.5 and 2.5 mi from the LNP site. Considering the size of red cockaded woodpecker home ranges of 100–400 ac (FWS 2003), the distance of these active clusters from the LNP site and the lack of suitable habitat onsite, no more than incidental use of LNP site by red cockaded woodpeckers would be expected.

<u>Florida Scrub Jay</u> (*Aphelocoma coerulescens*)
Federal – Threatened; Florida – Threatened

The Florida scrub jay occupies fire-dominated, low-growing oak scrub habitat found on well-drained sandy soils (generally corresponding to FLUCFCS 413 and 421) (FNAI 2009). Populations of this species may persist in areas with sparser oaks or overgrown scrub, but at lower densities. No Florida scrub jays were identified during field surveys of the LNP site (PEF 2009a), but the species has been documented in the site vicinity (PEF 2008a; FFWCC 2009a). Three historic records of scrub jays are associated with scrub oak habitat located 3 to 5 mi from the LNP site (PEF 2008a). Xeric, well-drained scrub habitats preferred by scrub jays are uncommon on the LNP site. No scrub oak species, a key indicator of potential habitat suitability, were identified during field surveys of the LNP site (PEF 2009h). The conversion of most upland habitats to coniferous pine plantations has removed suitable habitat for this species and reduced the likelihood for its occurrence onsite.

Wood Stork (*Mycteria americana*)
Federal – Endangered; Florida – Endangered

The wood stork is a highly colonial species that usually nests and feeds in freshwater and brackish wetlands (FWS 1997). Nesting occurs in a variety of inundated forested wetlands, including cypress stands and domes, mixed hardwood swamps, sloughs, and mangroves (FNAI 2009). Nesting colonies (rookeries) in central and northern Florida generally form in February and March. The species forages in a wide variety of shallow-water wetland habitats ranging from drainage ditches to marshes, ponds, and hardwood swamps. Wood storks are tactile rather than visual feeders, using their bills to probe shallow water for small fish, their primary prey. They feed preferentially in depressions where the prey can become concentrated during low-water periods.

Wood storks have been observed feeding in ditches and wetlands on the LNP site, but no nesting colonies have been detected (PEF 2009a, h). Suitable rookery habitat is limited on the site, primarily because of forest-management activities and a lack of suitable open-water habitat. The LNP site is not located within the core foraging area of any active wood stork rookery (FWS 2009b). Wood Storks have been observed roosting with other wading birds in forest stands located 8 to 9 mi west of the LNP site (Entrix 2009).

Other Wading Birds

Several other species of wading birds classified as Florida species of special concern have been observed foraging in wetlands on the LNP site (e.g., white ibis) or may occasionally feed there (e.g., little blue heron [*Egretta caerulea*]; snowy egret [*E. thula*]; tricolored heron, [*E. tricolor*]; and limpkin [*Aramus guarauna*]). Wading birds throughout Florida forage in a variety of permanently and seasonally flooded wetlands, creeks, ditches, ponds, and lakes. No wading-bird rookeries were observed on the LNP site (PEF 2009a). Suitable wading-bird rookery habitat is limited primarily because of forest-management activities. However, wading-bird rookeries are documented in the site vicinity along Lake Rousseau to the southeast of the LNP site (PEF 2008a). Wading bird roosts have been observed in forest stands located 8 to 9 mi west of the LNP site (Entrix 2009).

<u>Florida Sandhill Crane</u> (*Grus canadensis pratensis*)
Federal – Not Listed; Florida – Threatened

The Florida sandhill crane inhabits prairies, freshwater marshes and pasturelands throughout most of peninsular Florida, and will often forage on agricultural lands and golf courses (FNAI 2009). The species is nonmigratory and very sedentary, although it may forage widely. Nests consisting of mounds of herbaceous vegetation are built in shallow wetlands and marshes. Florida sandhill cranes are indistinguishable from greater sandhill cranes (*Grus canadensis tabida*), an unlisted migratory species that winters throughout much of Florida. Greater sandhill cranes generally arrive in October and depart in March (FNAI 2009). Although sandhill cranes were occasionally observed on the LNP site, none were detected during the breeding season and no nests were documented (PEF 2009a, h). There are no occurrence records for Florida sandhill crane from the project vicinity (PEF 2008a; FFWCC 2009a). This suggests that sandhill crane observations from the LNP site likely represent the unlisted greater sandhill crane.

<u>Florida Black Bear</u> (*Ursus americanus floridanus*)
Federal – Not Listed; Florida – Threatened

Florida black bears occupy expansive areas of upland forest and forested wetlands (FNAI 2009). Forested wetlands are particularly important for diurnal cover, and baygalls/bayheads (FLUCFCS 611) are important for cover and dens. No Florida black bears were identified during field surveys of the LNP site (PEF 2009a, h), and there are no records from the site vicinity (PEF 2008a; FFWCC 2009a). However, the species is known to inhabit the Goethe State Forest that abuts the northeastern boundary of the LNP site (FDACS 2009). Considering the large home range of black bears and the presence of forested swamps on the LNP site, it is possible Florida black bears may occasionally forage on the LNP site or traverse the site when moving across the regional landscape.

<u>Sherman's Fox Squirrel</u> (*Sciurus niger shermani*)
Federal – Not Listed; Florida – Species of Special Concern

Sherman's fox squirrels inhabit sandhills (generally corresponding to FLUCFCS 412), pine flatwoods (FLUCFCS 411), and pastures, as well as other open, ruderal habitats with scattered pines and oaks (FNAI 2009). The species is dependent upon on a variety of oaks for seasonal food and nest material. Longleaf pine cones and seeds are important foods as well. No Sherman's fox squirrels were identified during field surveys of the LNP site (PEF 2009a, h), and there are no species records from the site vicinity (PEF 2008a; FFWCC 2009a). However, the species is known to inhabit the Goethe State Forest that abuts the northeastern boundary of the LNP site (FDACS 2009). Sherman's fox squirrel has been eliminated from much of its former habitat as a result of conversion to pine plantation, row crops, or development (FNAI 2009).

The conversion of native upland habitats on the LNP site to coniferous pine plantations has removed most suitable habitat for this species and reduced the likelihood for its occurrence.

Florida Mouse (*Podomys floridanus*)
Federal – Not Listed; Florida – Species of Special Concern

The Florida mouse occupies dry upland communities with sandy soils, including scrub, sandhill (generally corresponding to FLUCFCS 412, 413, and 421), and ruderal sites where they inhabit burrows of the gopher tortoise (FNAI 2009). In the absence of gopher tortoises, the Florida mouse will dig its own burrow or use those of other mice. Although the Florida mouse was not identified during field surveys of the LNP site (PEF 2009a, h), the species is known in the site vicinity (PEF 2008a). Dry upland communities on the LNP site have been altered by forest management and do not provide good habitat for this species. Nonetheless, the presence of gopher tortoises indicates a potential for this species to occur on the LNP site.

Homosassa Shrew (*Sorex longirostris eionis*)
Federal – Not Listed; Florida – Species of Special Concern

Although the Homosassa shrew was once thought to be limited to a single locality (Homosassa Springs), its distribution has now been expanded to include the northern two-thirds of peninsular Florida (Jones et al. 1991). The species has been documented in a wide variety of habitats, including forested wetlands, xeric and hydric hammocks, pine flatwoods, pine sandhill, palmetto thickets, and clear-cuts. Although the Homosassa shrew was not identified during field surveys of the LNP site (PEF 2009a, h), suitable habitat for this species is present on the site.

Protected Plants

The PEF (2008a) Occurrence Report for the LNP site identifies several documented occurrences of protected plant species near the LNP site, but none for the site. PEF (2008a) biodiversity models also suggest the potential for several species to occur onsite, based upon suitable habitat and/or known occurrences in the vicinity. A Godfrey's swampprivet (*Forestiera godfreyi* – no Federal status, State Endangered) specimen was documented in 1937 just outside of the northwestern site boundary near US-19/US-98, and FNAI biodiversity models indicate that this species could occur on the LNP site (PEF 2008a). No recent documentation for this shrub is known. Pinewood dainties (*Phyllanthus leibmannianus* – no Federal status, State Endangered) were documented west of the LNP site. A record for corkwood (*Leitneria floridana* – no Federal status, State Threatened) exists northwest of the site, and FNAI biodiversity models also suggest this species could occur onsite (PEF 2008a). Spoon-leavf sundew (*Drosera intermedia* – no Federal status, State Threatened) was recorded in 1958 to the east of the LNP site in pine flatwoods and roadside swales, but no recent documentation is known. Several recent records for coastal mock vervain (*Glandularia maritima* – no Federal status, State Endangered) have been documented west of the LNP site in disturbed areas along the CFBC. PEF (2008a) biodiversity models indicate the potential for a number of other rare plants to occur in the vicinity of the LNP site wherever suitable habitat is available.

Recent surveys for listed plants were conducted several miles west of the LNP site for the proposed Tarmac King Road Limestone Mine. No Federally listed plants were observed, but six State-listed plants were detected during these surveys (Entrix 2009). These included corkwood, cardinal flower (*Lobelia cardinalis* – no Federal status, State Threatened), an unidentified spiny pod (*Matelea* spp. – no Federal status, State Endangered), angularfruit milkvine (*Matelea gonocarpos* – no Federal status, State Threatened), pinewood dainties and browneyed Susan (*Rudbeckia triloba var. pinnatiloba* – no Federal status, State Endangered).

No targeted surveys for individual protected plants have been conducted on the LNP site. However, PEF contractors recorded plant species during extensive pedestrian surveys conducted between September 2006 and November 2008, in conjunction with habitat mapping and wetland delineation efforts (PEF 2009h). No protected plants were identified during these surveys (PEF 2009a). Table 2-8 lists protected plant species that could occur on or in the vicinity of the LNP site, as derived from the PEF (2008a) report and biodiversity modeling. The conversion of much of the native vegetative communities to managed pine plantation reduces the likelihood that these rare plants would be present on the LNP site.

Other Important Terrestrial Species and Habitats

Levy County, along with adjacent Gulf Coast counties, is collectively known as Florida's Nature Coast. This area is valued for its vast natural areas, water, fish and wildlife resources, and scenic beauty. No unique or rare habitats, or habitats with priority for protection (other than the wetlands that are discussed in Section 2.4.1.1), are identified on the LNP site (PEF 2009a). Plant communities on the LNP site have been modified by years of intensive forest management that has included extensive soil disturbance, alterations to local drainage patterns, and the conversion of native habitats to planted pine plantations. However, several preserves and conservation areas are located near the LNP site, including the Goethe State Forest, Waccasassa Bay Preserve State Park, Big Bend Seagrasses Aquatic Preserve, Crystal River State Buffer Preserve, and the Marjorie Harris Carr Cross-Florida Greenway (Figure 2-17). The Withlacoochee River, located approximately 2 mi south of the LNP site, is designated by the State of Florida as an OFW.

Federal and State-listed species that constitute important species are summarized in Table 2-8. However, a variety of other important species may occur on the LNP site as well (Table 2-9). Although the bald eagle (*Haliaeetus leucocephalus*) was de-listed under the ESA in 2007, the species remains Federally protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. Bald eagles are locally common throughout peninsular Florida, preferring coastal areas and inland waterways where fish, waterfowl, and other prey are plentiful (FNAI 2009). Nests are usually located in tall trees that provide unobstructed views of the

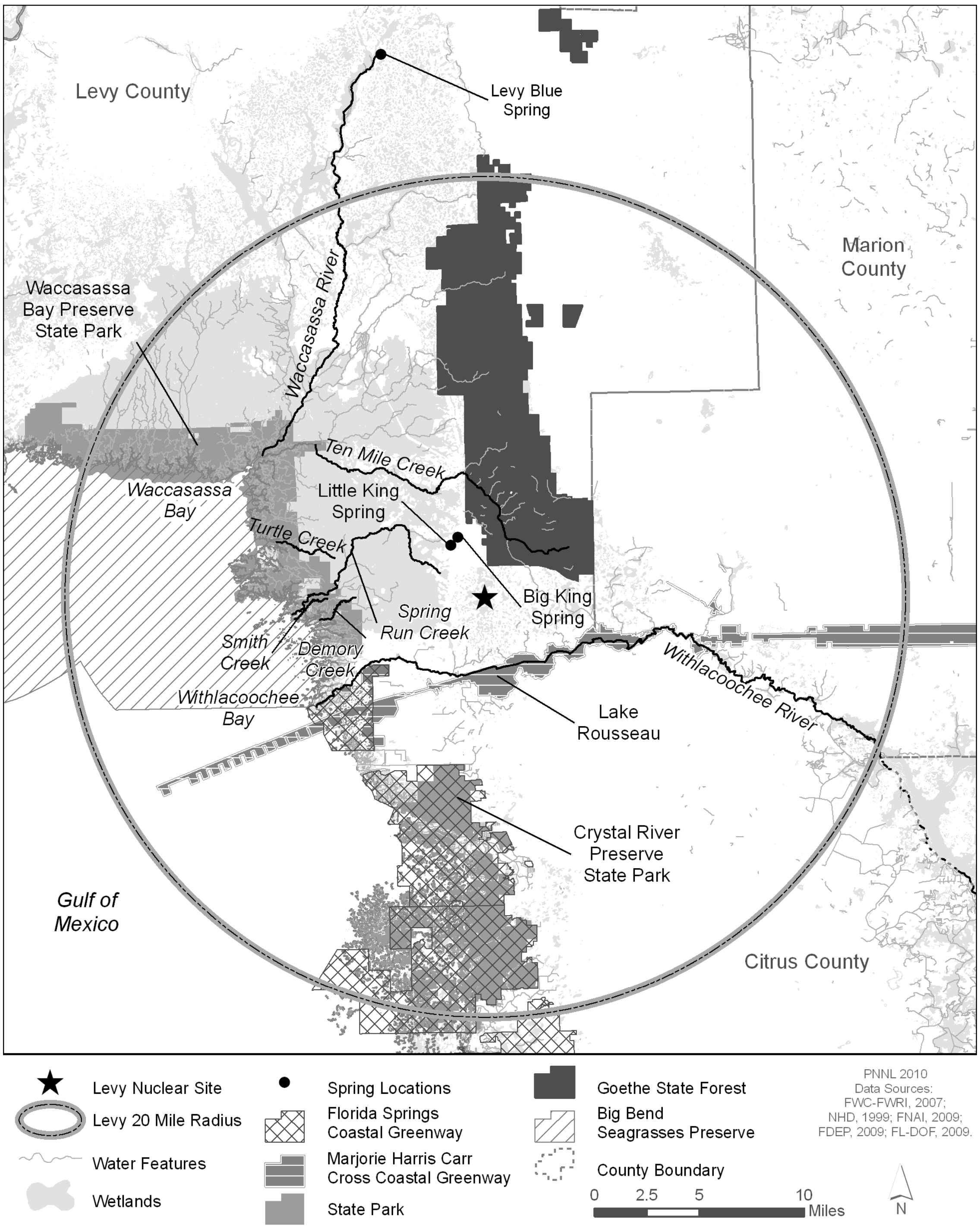


Figure 2-17. Important Natural Resources near the LNP Site

Table 2-9. Other Important Species That May Occur on the LNP Site and Associated Offsite Facilities[(a)]

Common Name/ Scientific Name	Type	Criteria	LNP Site	Associated Offsite Facilities: Up to First Substation	Associated Offsite Facilities: Beyond First Substation
Bald eagle *Haliaeetus leucocephalus*	Bird	Rare	✓	✓	✓
Whooping crane *Grus americana*	Bird	Threatened; Nonessential Experimental Population	✓	✓	✓
Northern bobwhite *Colinus virginianus*	Bird	Recreationally Valuable	✓	✓	✓
Wild turkey *Meleagris gallopavo*	Bird	Recreationally Valuable	✓	✓	✓
Mourning dove *Zenaida macroura*	Bird	Recreationally Valuable	✓	✓	✓
Common snipe *Gallinago gallinago*	Bird	Recreationally Valuable		✓	✓
Various waterfowl	Bird	Recreationally Valuable		✓	✓
White-tailed deer *Odocoileus virginianus*	Mammal	Recreationally Valuable	✓	✓	✓
Gray squirrel *Sciurus carolinensis*	Mammal	Recreationally Valuable		✓	✓
Feral hog *Sus scrofa*	Mammal	Nuisance	✓	✓	✓

Sources: PEF 2008a, 2009h; Golder Associates 2008.

(a) See Table 2-8 for Federally and State-listed terrestrial species that may occur on the LNP site and associated facilities.

surrounding landscape. Most bald eagles in northern and central Florida migrate north in late May through July after the conclusion of breeding. Bald eagles are occasionally observed in flight over the LNP site (PEF 2009a) and nest regularly in the general site vicinity (PEF 2008a). Two bald eagle nests are documented south of the LNP site in areas supporting LNP-associated facilities.

Two small populations of whooping crane (*Grus americana*) have been reintroduced into Florida. A nonmigratory population has been established at Kissimmee Prairie in central Florida, and a second migratory population is being established that would summer and breed in central Wisconsin and winter on the west-central coast of Florida (FWS 2010b). The Chassahowitzka National Wildlife Refuge was selected as the wintering site for the migratory population. Although the whooping crane is Federally listed as endangered, these populations are classified as nonessential experimental populations under Section 10(j) of the ESA (66 FR 33903). Under Section 10(j), nonessential experimental populations are treated as threatened and other provisions of the ESA are relaxed to allow for greater management flexibility and to garner positive public support. Relevant to the proposed LNP project, Section 7 interagency cooperation requirements are relaxed such that whenever experimental nonessential populations are outside of a National Wildlife Refuge or National Park, Federal agencies are only required to confer informally with the FWS when proposed actions are likely to result in jeopardy to the species.

Whooping cranes generally adhere to traditional ancestral breeding areas, migration routes and wintering grounds (66 FR 33903). The LNP site lies outside of the primary range of the nonmigratory Kissimmee Prairie population (RENEW/FWS 2007). However, whooping cranes from the nonmigratory population have ranged over much of peninsular Florida, from Baker County in the north to Lake Okeechobee in the south. Chassahowitzka National Wildlife Refuge, the selected wintering site for the migratory population, lies about 18 mi south of the LNP site. The migration route for this population includes the LNP site vicinity. Suitable whooping crane habitat in Florida includes shallow palustrine wetlands, lake edges, open grassprairie, pastureland and salt marsh. No whooping cranes were identified during field surveys of the LNP site (PEF 2009a, h). However, whooping cranes could pass near the LNP site during seasonal migrations, and birds from the nonmigratory population could stray into this area. Although recently cutover forestland and emergent wetlands could provide low foraging habitat, use of the LNP site by whooping crane is highly unlikely. Any use would likely be incidental in occurrence.

Recreationally valuable game species that occupy the LNP site include the white-tailed deer, northern bobwhite (*Colinus virginianus*), mourning dove, and wild turkey. These locally abundant species may be hunted subject to Florida hunting laws and regulations (Fla. Admin. Code 68A). White-tailed deer are multicover users that prefer habitats with abundant edge between grassy openings and forest cover. Northern bobwhites thrive in early successional environments, such as open fields or very young planted pine stands. Mourning doves are very adaptable and occupy open forests, forest-grassland edge, farmland, and suburban areas (Giuliano et al 2007). Wild turkeys prefer open mature stands of hardwoods interspersed with clearings and conifers (Allen et al. 1996). The feral hog, also a hunted species, is considered a nuisance species and is addressed in Section 2.4.1.1. Feral hogs may be hunted year-round.

2.4.1.4 Important Terrestrial Species and Habitats – Associated Offsite Facilities

This section summarizes information gathered about important terrestrial species and habitats that may occur on or in the vicinity of the associated offsite facilities, including the transmission lines required to integrate the electrical power generated at the proposed LNP into the Florida electrical grid system. Pursuant to the PPSA, PEF (2008a, 2009a) identified corridors within which most of the associated facilities would be sited. These corridors include approximately 180 mi of new transmission lines located over about 148 mi of corridor (multiple lines in some corridors) that would connect to the Florida electrical grid system (Golder Associates 2008; CH2M Hill 2009c). About 91 mi of the transmission lines would extend from the southern boundary of the LNP site to the first substation for each line. An additional 89 mi of transmission lines would extend beyond the first substations. Refer to Section 2.4.1.2 for a description of the corridors that would support the associated offsite facilities.

PEF (2009a) reviewed applicable agency websites, agency databases, and relevant literature pertaining to the associated offsite facilities to identify important species and habitats that may occur on or near corridors supporting the associated facilities. PEF completed pedestrian and vehicular field reconnaissance of accessible areas between October 2007 and January 2008 to characterize onsite habitats, document species presence, and identify areas that may support important terrestrial species and habitats (PEF 2008a, 2009a,h; Golder Associates 2008). After the final rights-of-way for the associated facilities are selected and acquired, PEF will complete a more detailed assessment pursuant to the PPSA, including targeted surveys for important species and the delineation of wetland boundaries (PEF 2009h).

Federally and State-Listed Terrestrial Species

Endangered, threatened, and other special-status Federal and State species that may occur on or near corridors supporting associated offsite facilities are presented in Table 2-8. The identified species represent a compilation of information from the following sources: Federally listed species from the FWS (2009a) website for Levy, Citrus, Marion, Sumter, Lake, Hernando, Pinellas, Hillsborough, and Polk Counties; State sensitive species list provided by the FFWCC as part of the FDEP (2009l) coordinated review of the Site Certification Application submitted by PEF for the LNP project; FFWCC Environmental Resource Analysis (FFWCC 2009a) conducted for the LNP project; FNAI threatened and endangered species lists and database occurrence records (Golder Associates 2008); and field survey of accessible areas (PEF 2008a, 2009a; Golder Associates 2008). The corridor segment between the LNP site and the CFBC received more extensive evaluation because much of this property has been purchased by PEF. Targeted surveys for gopher tortoise were conducted in portions of this corridor, particularly along the route for the heavy-haul road, the makeup-water pipeline, and the blowdown pipeline. No other surveys for listed species using accepted State or Federal survey protocols were conducted for the corridors. FDEP (2010a) would require protocol surveys for listed species that may occur on the final rights-of-way for the associated facilities prior to “clearing and construction” as a condition of certification.

As many as 32 listed wildlife species could occur in corridors supporting the associated offsite facilities (Table 2-8). For corridors extending from the LNP site to the first transmission substations, this includes 30 species – 5 mammals, 18 birds, 6 reptiles, and 1 amphibian. Listed species observed during reconnaissance surveys conducted by PEF (2008a, 2009a;

Golder Associates 2008) contractors include the Florida scrub jay, little blue heron, snowy egret, tricolored heron, white ibis, wood stork, American alligator, eastern indigo snake, and gopher tortoise. Additional PEF (2008a) and FWWCC (2009a) records exist for Sherman's fox squirrel, the wood stork, and the American alligator. Corridors extending beyond the first substations may support 30 listed species including 5 mammals, 19 birds, 5 reptiles, and 1 amphibian. Species observed during PEF reconnaissance surveys include Sherman's fox squirrel and gopher tortoise. Additional PEF (2008a) and FWWCC (2009a) records exist for the Florida black bear, southeastern American kestrel, and the wood stork. Suitable habitats used by listed wildlife species that may occur along corridors supporting associated offsite facilities are summarized in Table 2-8. Species associated with coastal tidelands and waters are generally limited to the corridor areas near the CREC. Other listed wildlife may occur throughout the corridors wherever suitable habitat is available.

In total, 76 plant species, Federally or State-listed as threatened or endangered, may occur within corridors supporting the associated offsite facilities (Table 2-8). All 76 of these plants are listed by the State of Florida, with 13 also Federally designated. None of these plants was identified during the pedestrian reconnaissance surveys completed between October 2007 and January 2008 for the corridors (PEF 2008a; Golder Associates 2008), but no targeted surveys for rare plants were conducted. Four documented occurrences of listed plants are known from the FNAI and FFWCC databases. Three species records exist for corridors extending from the LNP site to the first transmission substations, for pinewood dainties, longspurred mint (*Dicerandra cornutissima*), and coastal mockvervain. Pinewood dainties, a State endangered species, is known from floodplain and bottomland forests (generally corresponding to FLUCFCS 615, 617 and 630) and hydric hammocks (generally corresponding to FLUCFCS 617). This species was documented south of the CFBC in the corridor proposed for the 500-kV line that would extend from the LNP site to the Citrus substation. Preferred habitat for longspurred mint, a Federal and State endangered species, is sand pine forest (FLUCFCS 413) and scrub oak (generally corresponding to FLUCFCS 421). The detection area for this species lies within the eastern portion of the corridor proposed for the 500-kV line that would extend from the LNP site to the Central Florida South substation. Coastal mock vervain, a State endangered species, occurs in back dunes, dune swale, and coastal hammock habitats (generally corresponding to FLUCFCS 322, 425, 427 and 432). Coastal mock vervain was documented within the corridor for the blowdown pipeline between the makeup-water intake structure and the CREC. One record is also known from corridors past the first transmission substations for the giant orchid (*Pteroglossaspis ecristata*). Giant orchid, a State threatened species, occurs in sandhill (generally corresponding to FLUCFCS 412 and 421), scrub (generally corresponding to FLUCFCS 413), pine flatwoods (FLUCFCS 411), and pine rocklands habitats (do not occur in region of the Levy site or transmission lines). The detection area of this species lies within the corridor proposed for the 230-kV line that would extend from the Kathleen substation to the Lake Tarpon substation. Considering the linear extent of the associated facilities corridors and the variety of habitats through which they pass, it is possible that other listed plant species may be present within the associated offsite corridors.

Other Important Terrestrial Species and Habitats

No unique or rare habitats, or habitats with priority for protection (other than the wetlands that are discussed in Section 2.4.1.2) are identified for the associated offsite facilities corridors (PEF 2008a, 2009a; Golder Associates 2008). However, because of the linear extent of the associated facilities, there are a number of wildlife sanctuaries, refuges, and preserves that lie near or are crossed by the corridors. Corridors extending from the LNP site to first substations traverse through the Marjorie Harris Carr Cross-Florida Greenway, two State forests (Withlacoochee State Forest and Ross Prairie State Forest), the Halpata Tastanaki Preserve, and one OFW (Withlacoochee River, crossed three times). Other sanctuaries and preserves lie nearby, including the Goethe State Forest, Crystal River State Buffer Preserve, Potts Preserve, Gum Slough Conservation Easement, Lake Panasoffkee (OFW), and Flat Island Preserve. Corridors extending beyond the first substations traverse through the Withlacoochee State Forest, Chassahowitzka Wildlife Management Area, Annutteliga Hammock State Park, four OFWs (Blackwater Creek, Hillsborough River, Trout Creek, Cypress Creek), seven SWFWMD lands (Upper Hillsborough Recreation Area, Lower Hillsborough Wilderness Park, Lower Hillsborough Flood Detention Area, Morris Bridge Park, Trout Creek Park, Flatwoods Park, and Jefferson Road Equestrian Area Trail), and six county lands (Cone Ranch, Lake Park, Old Fort King Trail, Channel B Corridor, Rocky and Brushy Creek Greenway, and Northwest Preserve). Other sanctuaries and preserves lie nearby, including the Marjorie Harris Carr Cross-Florida Greenway, Crystal River State Buffer Preserve, Crystal River system (an OFW), Sand Hill Scout Reservation, Green Swamp Conservation Easement, Blackwater Creek Preserve, Hillsborough River State Park, Cypress Creek Preserve and Brooker Creek Preserve.

Bald eagles, delisted under the Federal ESA but still Federally protected under the Bald and Golden Eagle Protection Act, are locally common throughout peninsular Florida, preferring coastal areas and inland waterways where fish, waterfowl, and other prey are plentiful (FNAI 2009). Bald eagles may occur along the associated offsite facilities corridors wherever suitable habitat is available, and may include resident nesting pairs and winter migrants. Within corridors up to the first substation, two bald eagle nests are documented between the LNP site and the CFBC, and another nest lies within one-half mile of the transmission-line corridor near the CREC (PEF 2008a, 2009a; Golder Associates 2008). No documented bald eagle nests are known within corridors beyond the first substation, although Golder Associates (2008) did observe two large raptor nests during site reconnaissance surveys that could possibly be used by bald eagles. However, three bald eagle nests lie within one-half mile of the transmission-line corridors, including one near the CREC (noted above) that also lies adjacent to a corridor up to the first substation (PEF 2008a; Golder Associates 2008).

Whooping cranes, although rare, may occur within areas through which the associated offsite facilities corridors would pass. Substantial portions of the transmission-line corridors (including both corridors up to the first substation and corridors beyond the first substation) lie within the primary range of the nonmigratory Kissimmee Prairie population (RENEW/FWS 2007). The proposed 230-kV line extending from the CREC switchyard to the Brookridge substation would pass within 2 mi of the Chassahowitzka National Wildlife Refuge, the wintering site for the migratory whooping crane population. There are no occurrence records for whooping crane from the associated offsite facilities corridors (PEF 2008a; FFWCC 2009a), and no whooping cranes were observed during reconnaissance surveys conducted by PEF contractors (PEF 2008a, 2009a; Golder Associates 2008). Nevertheless emergent wetlands, maintained grasslands and other suitable foraging habitats lie within these corridors. It is also possible that whooping cranes may cross these corridors during their seasonal migrations or normal range movements.

Because of the numerous habitats through which the associated facilities corridors pass, a variety of recreationally valuable game species are expected to occur wherever suitable habitat is present. These include species associated with mixed forests, such as the gray squirrel and wild turkey; multicover users that prefer forest-grassland edge such as the white-tailed deer and mourning dove; species that thrive in early successional environments such as the northern bobwhite and eastern cottontail; freshwater marsh-associated species such as the common snipe (*Gallinago gallinago*) and common moorhen; and a variety of waterfowl whenever open water is present. The feral hog, a recreationally hunted species that is also considered a nuisance species, is expected to occur in mixed habitats along the corridors as well. Table 2-9 presents a summary of the other important species that may occur on the associated offsite facilities corridors. Because landscapes associated with the corridors share similar habitats and levels of disturbance, these game species are expected to be equally common in corridors up to the first substations and corridors beyond the first substations.

2.4.1.5 Terrestrial Monitoring

PEF conducted terrestrial ecological baseline monitoring on the proposed 3105-ac LNP site between September 2006 and April 2009 (PEF 2009h). Pedestrian surveys were conducted to verify and map cover types, describe and delineate wetland boundaries, document the presence of wildlife and wildlife habitat, and identify areas that may support important terrestrial species and habitats. Targeted surveys for gopher tortoise were conducted on the LNP site in 2007 and gopher tortoise burrows were documented. No other listed species surveys meeting accepted State or Federal survey protocols were conducted on the LNP site. Pursuant to the PPSA, surveys following published protocols for all State-listed species (excluding plants) that may occur on the LNP site would be required prior to “clearing and construction” under a post-certification condition imposed by the FDEP (2010a). Coordination with the FFWCC would be required to determine appropriate mitigation for any affected species.

Pedestrian and vehicular field reconnaissance was completed for accessible portions of corridors supporting the associated offsite facilities by PEF between October 2007 and January 2008 (PEF 2008a, 2009a, h; Golder Associates 2008). These surveys were to characterize offsite corridor habitats, document species presence, and identify areas that may support important terrestrial species and habitats. Targeted surveys for gopher tortoise were conducted in portions of the corridor extending from the LNP site to the CFBC, particularly along the route for the heavy-haul road, the makeup-water pipeline, and the blowdown pipeline. No other listed species surveys meeting accepted State or Federal survey protocols were conducted. Wetlands were delineated for the corridor extending from the LNP site to the CFBC. Wetlands in the remaining associated facilities corridors were identified using the cover type mapping; no formal delineations were conducted. After the final rights-of-way for the associated offsite facilities are selected and acquired, PEF would be required to complete a more detailed assessment of terrestrial resources pursuant to the PPSA. This would include protocol surveys for all listed species (excluding plants) that may occur within the rights-of-way and the delineation of wetlands prior to “clearing and construction,” under a post-certification condition imposed by the FDEP (2010a). Coordination with the FFWCC would be required to determine appropriate mitigation for any affected species.

There are no other known ecological or biological studies ongoing at the LNP site or the associated offsite facilities beyond those conducted in support of this project.

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the LNP site and other areas likely to be affected by the construction, operation, or maintenance of proposed LNP Units 1 and 2. It describes the spatial and temporal distribution, abundance, life-history stages, and attributes of biotic assemblages on which the proposed action could have an impact, and it identifies “important” or irreplaceable aquatic natural resources and the location of sanctuaries and preserves that might be affected by the proposed action.

The aquatic communities associated with the LNP site include the CFBC, the Withlacoochee River, and the Gulf of Mexico. The LNP site does not have any waterbodies adjacent to it, although it does have a few onsite permanent and temporal shallow ponds. The CFBC is located 3.2 mi to the south of the LNP site and extends 16.8 mi from Lake Rousseau at the Inglis Lock out into the Gulf of Mexico.

There are no aquatic sanctuaries or preserves that could be affected by the proposed action. The nearest managed areas are the Big Bend Seagrasses Aquatic Preserve (FDEP 1988), St. Martins Marsh (FDEP 1987), and Crystal River National Wildlife Refuge (Buckingham 1989). Big Bend Seagrasses Aquatic Preserve, which is managed by FDEP, is approximately 5 mi to the north along the Gulf Coast of Florida from the mouth of the CFBC, and extends up along the coast and up to 8 mi offshore to the St. Marks National Wildlife Refuge to cover 945,000 ac. St.

Martins Marsh, also managed by FDEP, encompasses 23,000 ac in the nearshore and offshore region due west of the city of Crystal River, 3.5 mi to the south of the CREC discharge location, and 6 mi to the south of the mouth of the CFBC. Both aquatic preserves were established to protect seagrass bed habitats, which provide nursery areas for finfish and shellfish, as well as foraging resources for local birds and aquatic vertebrates. The Crystal River National Wildlife Refuge is managed by the FWS and comprises the Kings Bay headwaters of Crystal River, which lie 10 mi inland from the mouth of Crystal River on the Gulf of Mexico. The Crystal River National Wildlife Refuge was designated to protect the Florida manatee (*Trichechus manatus latirostris*) and its habitat. The CREC discharge into the Gulf of Mexico is approximately 2.5 mi south of the mouth of the CFBC (see Figure 2-18).

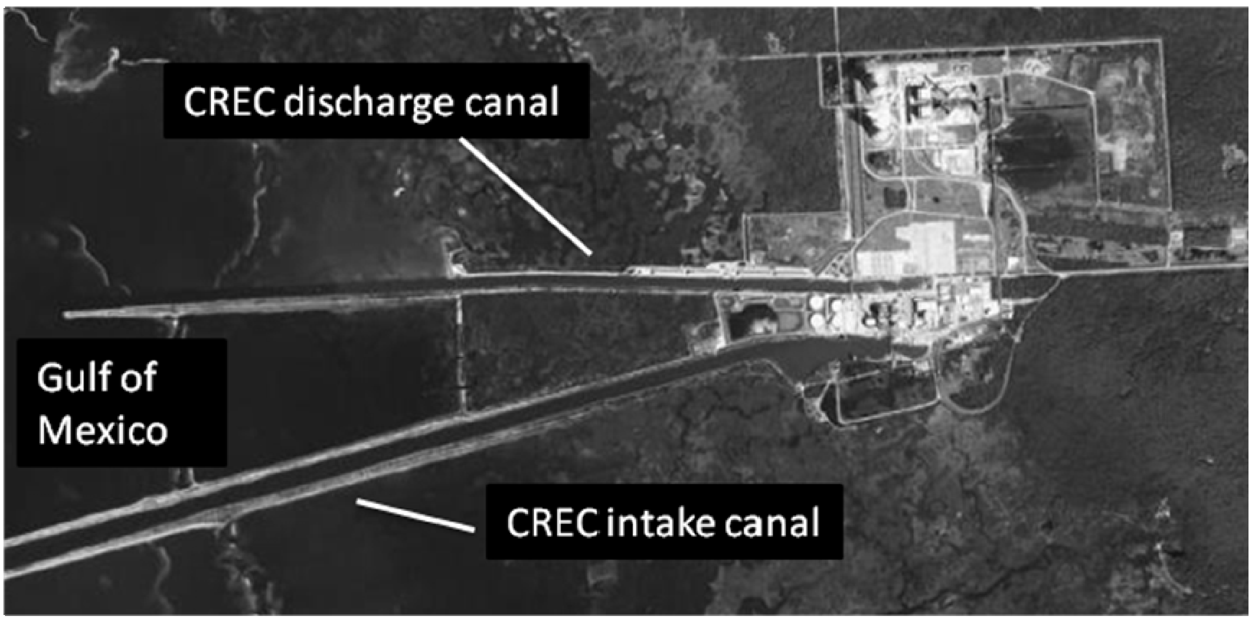


Figure 2-18. Location of Crystal River Energy Complex (CREC) Discharge Canal in Relation to the Gulf of Mexico (PEF 2009a)

2.4.2.1 Aquatic Resources – Site and Vicinity

The potential for impacts from intake construction and operation of proposed LNP Units 1 and 2 on aquatic biota would primarily affect organisms inhabiting the CBFC, the OWR below Rousseau Dam, and the CREC discharge area in the Gulf of Mexico.

LNP Site

Permanent wetlands and temporal shallow ponds on the LNP site may support small freshwater fish such as killifish, minnows, and mosquito fish. However, no fish were observed during site sampling events, and no known protected aquatic species were found in any of these freshwater ponds. Ponds on the LNP site were examined visually for aquatic species. Due to the shallow or seasonal nature of these habitats, they were not observed to have active populations of aquatic species. Years of forest plantation activities on the LNP site potentially contributed to the lack of persistent aquatic communities in these resources (PEF 2009a).

The Cross Florida Barge Canal

In an effort to provide maritime navigation between the Atlantic Ocean and the Gulf of Mexico, construction of a 12-ft-deep by 150-ft-wide Florida cross-peninsular waterway began in the mid-1930s (Noll and Tegeder 2003). Originally intended to be a 171 nautical mile canal, only 4 percent was complete by 1965 due to lack of funding and congressional support for several decades. Continued local opposition and lack of government funding eventually prompted an injunction that halted the construction in 1971, leaving a western portion from the newly constructed Inglis Lock to the Gulf of Mexico and an eastern stretch forming Lake Ocklawaha between the St. Johns Lock and Rodman Dam. Official deauthorization for the barge canal came in 1991, and the Cross-Florida Greenway State Recreation and Conservation Area took over the former barge canal properties. In 1998, the canal and associated lands were renamed the Marjorie Harris Carr Cross-Florida Greenway and Conservation Area (Noll and Tegeder 2003). The western section of the CFBC affiliated with the proposed action is the 7.4-mi stretch from Inglis Lock west to the Gulf of Mexico; it ranges in depth from 8.6 to 18.2 ft and in width from 207 to 262 ft. The Inglis Lock is no longer functional (FDEP 2005). The Lock allows some leakage of freshwater from Lake Rousseau into the CFBC. The Inglis Dam was built in 1909 to impound the Withlacoochee River to form 3700-ac Lake Rousseau. An approximately 1.5-mi portion of the historical downstream segment of the OWR below the dam still runs into the western CFBC below the Inglis Lock. A 1.7-mi channel was constructed upstream of the Inglis Lock that parallels the CFBC reconnecting Lake Rousseau waters with the downstream 11-mi portion of the Withlacoochee River, thus serving as a bypass around the CFBC. The western portion of the CFBC lies 8 mi to the south of the proposed LNP and is the preferred water source for providing LNP cooling water. Freshwater influence into the CFBC comes from seepage around the Inglis Lock, freshwater springs in the CFBC near the Inglis Lock, and discharge from Lake Rousseau over the Inglis Dam via the OWR to the CFBC. The water-control structures near the LNP site are shown in Figure 2-9.

The CFBC discharges into the Withlacoochee Bay estuary in the Gulf of Mexico and is influenced by tidal changes. Water-quality characteristics show a wedge of saltwater extending from the surface waters where the CFBC meets the Gulf of Mexico up towards the Inglis Lock where persistent salinities range from an average of 5.75 practical salinity scale (pss) units at the surface to 16.87 pss at a depth of 4 m, and salinities just outside the mouth of the CFBC in the Gulf of Mexico average 17.83 pss at the surface and 25.91 pss at 4 m (CH2M Hill 2009b). Sediment profiles for the CFBC within the 7.4 mi stretch from the Inglis Lock to the Gulf of Mexico are predominated by 49.2 to 60.7 percent silt, 17.1 percent sand, and 28.6 percent clay.

Just outside the mouth of the CFBC, the sediment profile shifts dramatically to primarily sand (average 83 percent) as is common with nearshore estuarine habitat. Total organic carbon is highest near the Inglis Lock at 60,714 mg/kg and decreases to 7417 mg/kg at the offshore sampling station. Total dissolved solids and total suspended solids are lowest near the Inglis Lock and increase with increasing salinity out into the Gulf of Mexico. Likewise, dissolved oxygen is lowest near the bottom of the CFBC at the Inglis Lock and increases over the length of the CFBC to generally being higher and more uniform over depth at the offshore sampling locations (CH2M Hill 2009b). These metrics indicate a poor-quality aquatic habitat area near the Inglis Lock.

Sampling along the extent of the CFBC was conducted from October 2007 through November 2008 at stations 1 through 4 within the CFBC and nearshore Gulf of Mexico (Figure 2-19). The aquatic species that were identified from the sampling events are listed in Table 2-10, Table 2-11, and Table 2-12.

Shoreline handpicking for invertebrate organisms revealed dominant species at each of the three sampling station locations in the CFBC. Nearest the Inglis Lock, barnacle (*Chthamalus fragilis*) and false dark mussel (*Mytilopsis leucophaeata*) were the dominant species. At station 2 near the US-19 overpass, scorched mussel (*Brachidontes exustus*), false dark mussel, barnacle, mud crab (*Panopeus herbstii*), and acorn barnacle (*Balanus* spp.) were dominant. Station 3 was dominated by green porcelain crab (*Petrolisthes armatus*), hooked mussel (*Ischadium recurvum*), mud crab, and acorn barnacle. Oysters (*Crassostrea virginica*) were also noted along the shoreline near the mouth of the CFBC at station 3 (CH2M Hill 2009b).

Benthic invertebrates were collected using petite Ponar dredge, crab traps, trawls, and shoreline handpicking (PEF 2009a). Figure 2-19 shows the locations for aquatic species sampling in the CFBC. Benthic infauna were dominated by polychaete worms (75 percent of the mean total) with amphipods being the next abundant in collection across all sampling events and stations. Station 1 near the Inglis Lock had the lowest overall mean abundance and station 2 had the highest (CH2M Hill 2009b). Benthic species diversity is listed in Table 2-10.

Motile macroinvertebrates were sampled by trawl and crab-trap in the CFBC in October/November 2007, December 2007, May 2008, and August 2008 (Table 2-11). Trawling resulted in blue crab (*Callinectes sapidus*), brief squid (*Lolliguncula brevis*), pink shrimp (*Farfantepenaeus duorarum*), and mud crab comprising the majority of the total catch at 70 percent, with springtime sampling yielding the highest catch per unit effort (CPUE). Stations 3 and 2 had the highest overall abundances, and no macroinvertebrates were collected at station 1. Ten crab traps were baited and caught only blue crab with station 3 collecting the highest abundance (CH2M Hill 2009b).

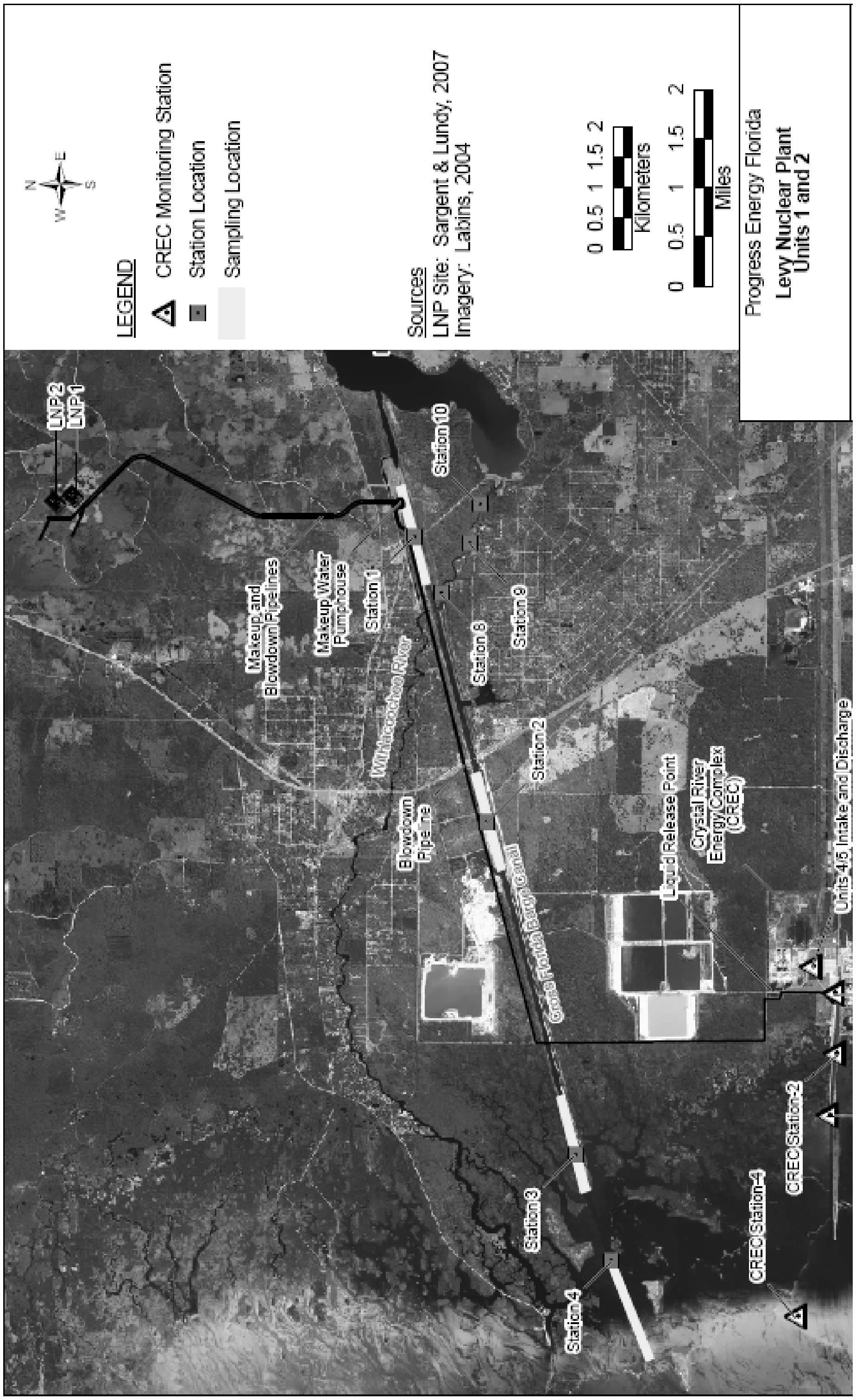


Figure 2-19. Aquatic Sampling Locations in the CFBC and OWR (CH2M Hill 2009b)

Table 2-10. Benthic Invertebrate Diversity for the CFBC, OWR, and CREC Sampling Events

	Mean Abundance (number of individuals/m^2)								
Taxon Group	**CFBC 1**	**CFBC 2**	**CFBC 3**	**CFBC 4**	**OWR 8**	**OWR 9**	**OWR 10**	**CREC 3**	**CREC 4**
Echinodermata	0	0	14	79	0	0	0	22	57
Chaetognatha	0	0	0	0	0	0	0	7	0
Phoronida	0	0	0	301	0	0	0	0	7
Nemertea	0	0	50	129	0	57	0	50	43
Sipuncula	0	0	0	11	0	0	0	36	29
Hirudinea	0	0	0	0	14	0	531	0	0
Oligochaeta	0	7	1353	671	0	0	20,007	201	509
Polychaeta	43	13,455	5134	6336	1105	1005	172	10,986	7090
Gastropoda	7	36	22	176	57	531	144	151	301
Bivalvia	0	43	50	377	631	603	388	50	639
Aplacophora	0	0	0	22	0	0	0	0	0
Platyhelminthes	0	0	0	25	0	0	0	0	14
Decapoda	4	43	83	68	0	0	0	22	144
Amphipoda	0	380	18	657	115	301	1579	244	222
Cumacea	0	47	416	97	0	0	0	0	22
Isopoda	0	0	0	14	0	0	517	14	29
Mysida	0	0	7	22	0	0	0	7	65
Tanaidacea	0	0	0	65	0	0	0	100	0
Sessilia	0	0	0	7	0	0	0	0	0
Diptera	0	0	0	4	5009	531	4736	0	0
Hemiptera	0	0	0	0	0	0	0	0	7
Trichoptera	0	0	0	0	0	0	86	0	0
Cnidaria	0	4	7	32	0	0	0	129	7
Porifera	0	0	0	0	0	0	0	22	7

Source: CH2M Hill 2009b.

Table 2-11. Motile Macroinvertebrates Sampled in the CFBC and CREC with Catch per Unit Effort (CPUE) >1.0 from October 2007 Through November 2008 by Trawl and Crab Trap

Common Name	Scientific Name	Total Catch Per Unit Effort Across Trawl and (Crab Trap) for All Sampling Events					
		CFBC 1	CFBC 2	CFBC 3	CFBC 4	CREC 3	CREC 4
Jellyfish	Cyaneidae	-	1.5	-	-	-	-
Common eastern nassa	*Nassarius vibex*	-	-	-	-	-	1.5
Atlantic brief squid	*Lolliguncula brevis*	-	-	5	-	-	2
Palaemonid shrimp	Palaemonidae	-	-	-	-	-	1.5
Pink shrimp	*Farfantepenaeus duorarum*	-	1.5	2.5	-	-	5.5
Hippolyte shrimp	*Hippolyte* sp.	-	-	-	-	-	1.5
Decorator crab	*Stenocionops furcata*	-	-	-	-	-	2
Yellowline arrow crab	*Stenorhynchus seticornus*	-	-	-	-	-	7
Hermit crab spp.	*Pagurus* spp.	-	-	-	3	-	-
Mud crab	Xanthidae	-	-	-	3.5	3	-
Florida stone crab	*Menippe mercenaria*	-	-	-	-	(3.6)	2 (1.6)
Portunid crab	*Portunus* sp.	-	-	-	-	-	1.5
Blue crab	*Callinectes sapidus*	-	4.5 (2.5)	4 (4.3)	-	-	-

Source: CH2M Hill 2009b.

Table 2-12. Fish Species Sampled in the CFBC, OWR, and CREC with CPUE >1.0 from October 2007 Through November 2008 by Beach Seine, Trawl, Cast Net, Gill Net, and Minnow Trap

Common Name	Scientific Name	Total Number Collected Across All Sampling Gear and Events								
		CFBC 1	CFBC 2	CFBC 3	CFBC 4	OWR 8	OWR 9	OWR 10	CREC 3	CREC 4
Spinner shark	*Carcharhinus brevipinna*	-	-	-	-	-	-	-	4	1
Blacktip shark	*Carcharhinus limbatus*	-	-	-	-	-	-	-	-	7
Bull shark	*Carcharhinus leucas*	-	8	-	-	-	-	-	1	-
Bonnethead shark	*Sphyrna tiburo*	-	-	-	2	-	-	-	-	1
Cownose ray	*Rhinoptera bonasus*	-	-	1	-	-	-	-	-	3
Spotted eagle ray	*Aetobatus narinari*	-	-	-	-	-	-	-	2	1
Atlantic stingray	*Dasyatis sabina*	-	1	-	2	-	-	-	1	1
Southern stingray	*Dasyatis americana*	-	-	-	2	-	-	-	-	1
Longnose gar	*Lepisosteus osseus*	2	-	1	3	-	-	-	-	1

Table 2-12. (contd)

Common Name	Scientific Name	Total Number Collected Across All Sampling Gear and Events								
		CFBC 1	**CFBC 2**	**CFBC 3**	**CFBC 4**	**OWR 8**	**OWR 9**	**OWR 10**	**CREC 3**	**CREC 4**
Tidewater silverside	*Menidia peninsulae*	-	-	-	-	-	-	-	113	-
Inland silverside	*Menidia beryllina*	-	-	-	-	7	-	4	-	-
Halfbeaks	Hemiramphidae	-	-	-	-	-	-	-	10	-
Atlantic needlefish	*Strongylura marina*	7	2	9	3	-	-	-	2	1
Redfin needlefish	*Strongylura notata notata*	2	-	4	-	-	-	-	3	-
Killifishes	*Fundulus* spp.	-	-	-	-	-	-	-	60	-
Seminole killifish	*Fundulus seminolis*	-	-	-	-	-	-	22	-	-
Bluefin killifish	*Lucania goodei*	-	-	-	-	-	-	97	-	-
Goldspotted killifish	*Floridichthys carpio*	7	-	-	-	-	-	-	285	-
Mullets	Mugilidae	-	9	30	-	-	-	-	-	-
Striped (black) mullet	*Mugil cephalus*	8	6	24	35	-	-	-	21	9
White mullet	*Mugil curema*	8	27	14	51	-	-	-	36	1
Atlantic spadefish	*Chaetodipterus faber*	-	-	2	-	-	-	-	2	3
Gobys	Gobiidae	4	20	13	7	-	-	-	1	2
Skilletfish	*Gobiesox strumosus*	-	4	2	-	-	-	-	-	-
Sunfishes	Centrarchidae	4	-	-	1	-	1	4	-	-
Largemouth bass	*Micropterus salmoides*	1	-	-	-	1	5	17	-	-
Silver perch	*Bairdiella chrysoura*	-	95	398	246	-	-	-	1	149
Common snook	*Centropomus undecimalis*	-	4	-	-	-	-	-	1	-
Whitefin sharksucker	*Echeneis neucratoides*	-	-	1	1	-	-	-	-	-
Mojarras	Gerreidae	-	-	8	-	3	-	-	38	1
Spotfin mojarra	*Eucinostomus argenteus*	198	290	125	37	4	-	-	84	100

Table 2-12. (contd)

Common Name	Scientific Name	Total Number Collected Across All Sampling Gear and Events								
		CFBC 1	**CFBC 2**	**CFBC 3**	**CFBC 4**	**OWR 8**	**OWR 9**	**OWR 10**	**CREC 3**	**CREC 4**
Polka-dot batfish	*Ogcocephalus cubifrons*	-	-	-	4	-	-	-	-	2
Grunts	Haemulidae	-	-	2	1	-	-	-	-	-
Pigfish	*Orthopristis chrysoptera*	-	2	6	11	-	-	-	3	28
Snappers	Lutjanidae	8	20	14	-	-	-	-	5	2
Atlantic croaker	*Micropogonias undulatus*	-	8	2	1	-	-	-	-	2
Black drum	*Pogonias cromis*	4	13	-	1	-	-	-	11	1
Red drum	*Sciaenops ocellatus*	2	1	-	-	-	-	-	1	1
Spot	*Leiostomus xanthurus*	-	17	-	17	-	-	-	-	3
Sand seatrout	*Cynoscion arenarius*	-	23	16	12	-	-	-	-	4
Spotted seatrout	*Cynoscion nebulosus*	-	-	-	-	-	-	-	-	5
Spanish mackerel	*Scomberomorus maculatus*	-	-	2	4	-	-	-		5
Atlantic bumper	*Chloroscombrus chrysurus*	-	6	4	24	-	-	-	-	29
Leatherjacket	*Oligoplites saurus*	-	-	1	1	-	-	-	4	-
Bay anchovy	*Anchoa mitchilli*	100	706	704	125	1	2	-	-	1
Striped anchovy	*Anchoa hepsetus*	2	4	3	-	-	-	-	-	-
Atlantic thread herring	*Opisthonema oglinum*	-	-	2	2	-	-	-	-	10
Herrings	Clupeidae	4	-	-	-	-	-	-	-	-
Ladyfish	*Elops saurus*	9	15	24	6	-	-	-	-	1
Gulf menhaden	*Brevoortia patronus*	591	73	9	226	-	-	-	-	-
Yellowfin menhaden	*Brevoortia smithi*	-	1	3	-	-	-	-	-	17
Scaled sardine	*Harengula jaguana*	24	41	47	21	1	-	-	-	-
Pinfish	*Lagodon rhomboides*	13	54	61	26	2	-	-	2	91
Sheepshead	*Archosargus probatocephalus*	9	6	-	-	1	1	-	63	2
Southern kingfish	*Menticirrhus americanus*	-	-	1	6	-	-	-	-	-

Table 2-12. (contd)

Common Name	Scientific Name	Total Number Collected Across All Sampling Gear and Events								
		CFBC 1	**CFBC 2**	**CFBC 3**	**CFBC 4**	**OWR 8**	**OWR 9**	**OWR 10**	**CREC 3**	**CREC 4**
Crevalle jack	*Caranx hippos*	-	2	-	-	-	-	-	1	1
Blue runner	*Caranx crysos*	-	-	-	-	-	-	-	-	4
Hardhead catfish	*Ariopsis felis*	-	5	18	33	-	-	-	6	11
Gafftopsail catfish	*Bagre marinus*	2	2	2	-	-	-	-	-	5
Flounders	Paralichthyidae	-	1	2	6	-	-	-	-	1
Pufferfish	*Spheroides* spp.	-	1	1	-	-	-	-	-	1

Source: CH2M Hill 2009b.

Plankton tows were used to measure the holoplankton, meroplankton, and ichthyoplankton abundance at stations 1–4 along the CFBC. Total zooplankton abundances increased from station 1 near the Inglis Lock to station 4 outside the mouth of the CFBC for both nighttime and daytime collections, with significantly higher abundances in the spring (CH2M Hill 2009b). Holoplankton (dominated by mud crab larvae and copepods) made up the largest fraction of all zooplankton at 60 percent total abundance. Station 1 had significantly less abundance than stations 2 through 4 where holoplankton were more abundant at night. Meroplankton (dominated by Panopeidae crab larvae) represented 38 percent of all zooplankton and had higher abundances in the spring. Meroplankton abundance decreased from the Inglis Lock to the Gulf of Mexico during the day, but was more variable at night. Ichthyoplankton made up only 2 percent of the total abundance. Significant differences were observed between stationsfor eggs, but larval abundances accounted for the higher abundances at station 4. Anchovy eggs were dominant with 97 percent of all eggs collected during the day and 75 percent during the night. Gobiidae and Engraulidae species accounted for 88 percent of the mean total for larval species collected. Ichthyoplankton was most abundant at the offshore station 4.

Fish species were collected from the CFBC using beach seines, gill nets with varying mesh sizes, baited minnow traps, radius cast nets, and otter trawls pulled within 1 mi of the station location. Results from fish sampling are listed in Table 2-12 by collection location. Represented species are listed if the CPUE was greater than 1.0 or the species was caught in more than one location. CPUE is a measure of the density or population size of the fish species. Large CPUEs indicate large populations because many individuals are caught for every unit of fishing effort. Beach seining was conducted in October/November 2007, December 2007, June 2008, and August/September 2008 for stations 1, 2, and 3. Overall abundances were highest at station 1, closest to the proposed intake, predominantly due to large numbers of menhaden and bay anchovy (*Anchoa mitchilli*) collected during the June 2008 sampling event. Other dominant species caught by beach seine included spotfin mojarra (*Eucinostomus argenteus*) (CH2M Hill 2009b).

Gill-net sampling with variable mesh sizes of 1 in. to 6 in. was performed for all four stations in October 2007, December 2007, June 2008, and August 2008. Scaled sardine (*Harengula jaguana*) was the most abundant fish caught during all four sampling events, with spotfin mojarra and ladyfish (*Elops saurus*) combining to account for 77 percent of the total catch. Station 3 had the highest abundances and station 1 had the lowest (CH2M Hill 2009b).

Ten minnow traps were baited for sampling performed in October/November 2007, December 2007, May/June 2008, and August 2008. Silver perch (*Bairdiella chrysoura*) was the most abundant species caught with spotfin mojarra, several goby species, and pinfish (*Lagodon rhomboides*) collectively accounting for 93 percent of the total fish abundance. Seasonal differences were evident with the highest abundances occurring during the May 2008 sampling event. Station 1 had the highest catches and stations 3 and 4 had the lowest; however, over a year of sampling by minnow trap, a total of only 188 fish were collected (CH2M Hill 2009b). Cast nets were thrown between 40 and 50 times from a boat for sampling events occurring in October/November 2007, December 2007, May 2008, and August 2008. Gulf menhaden (*Brevoortia patronus*) were caught as the most abundant species with spotfin mojarra, white mullet (*Mugil curema*), pinfish, striped mullet (*Mugil cephalus*), and scaled sardine other abundant species caught during sampling. Fall and winter sampling had the highest CPUE with station 4 yielding overall highest numbers, followed by station 3 and stations 1 and 2 having the least (CH2M Hill 2009b).

Trawling was performed to examine the presence of demersal species in October 2007, December 2007, May 2008, and August 2008. Bay anchovy and silver perch were the most abundant fish caught, representing 81 percent of the total CPUE. Other abundant species included spotfin mojarra, pinfish, and spot (*Leiostomus xanthurus*). As with cast netting, the fall and winter sampling events yielded the greatest CPUE, and station 2 had the highest abundances (CPUE 744), followed closely by stations 3 and 4, while station 1 had significantly less (6) (CH2M Hill 2009b).

Overall, the results of fish, plankton, and macroinvertebrate sampling in the CFBC indicate a biologically diverse and dynamic aquatic community at the offshore and nearshore stations 4 and 3, respectively (see Table 2-10, Table 2-11, and Table 2-12). Station 2 in the CFBC near the US-19 overpass appears to have a unique community made up of large numbers of polychaete worms and highly predatory fish. Station 1 near the Inglis Lock has a less biodiverse community, but still has appreciable numbers of sediment-dwelling invertebrates and collections of pelagic species that use the fresher water habitat on a seasonal basis (CH2M Hill 2009b).

Old Withlacoochee River

The OWR, which flows from below the Inglis Dam into the CFBC, is approximately 1.5 mi in length, and varies in width from 20 to 30 m across. The flow within the OWR is variable primarily due to weather patterns and the need to control Lake Rousseau water levels during rain events by spill over the Inglis Dam into the OWR. The periodic higher flows have led to scouring of the bottom habitat down to bedrock in the center of the OWR, and the sediments along the sides are primarily sand mixed with organic materials (CH2M Hill 2009b). Salinity profiles in this remnant arm of the Withlacooche River range from 0.14 pss below the Inglis Dam to 4.38 pss at the 1-m depth where the OWR joins with the CFBC. Sampling was conducted at the junction of the OWR with the CFBC (station 8), halfway between the junction and the Inglis Dam (station 9), and just downstream of the Inglis Dam (station 10) within this portion of the OWR in June and August 2008 (CH2M Hill 2009b). Analytical chemistry analysis of water samples show no significant differences in ammonia, nitrate, nitrite, total nitrogen, organophosphate, total phosphate, chlorophyll a, or total suspended solids between the three sampling stations for the June sampling event. Dissolved oxygen was highest near Inglis Dam following a high-volume water release during the August sampling, which also significantly lowered the nitrate/nitrite concentration (CH2M Hill 2009b).

Biological sampling in the OWR was performed using beach seine, cast net, minnow trap, and crab traps. Gill nets and trawling were not used because manatees were present in the river. Crab traps yielded only two crustaceans and were not considered further in biological analyses. Fish caught near the Inglis Dam were representative of fish species that prefer freshwater conditions with killifish and bass representing the abundant species at that location. In a similar fashion, fish caught near the junction of the OWR and the CFBC were represented by silverside and mojarra species, which were also caught in the CFBC and prefer more saline environments. The midway location for sampling did not yield as many species as either of the other locations and may be due to the variable salinity conditions for that region. Benthic macroinvertebrate sampling mirrored the fish sampling results with euryhaline dipteran species predominant at the CFBC-OWR junction station, freshwater oligochaetes and amphipods at the Inglis Dam station, and a paucity of organisms and limited diversity at the midpoint station (Table 2-10 and Table 2-12) (CH2M Hill 2009b).

Crystal Bay

Crystal Bay in the Gulf of Mexico is the current site for the CREC discharge structure that discharges 1897.9 to 1613 Mgd of water used for cooling one nuclear and four fossil-fuel power plants. A 1.6-mi-long and 10-ft-deep discharge canal carries CREC discharge to the bay, which is immediately bordered along the south side by a spoil bank and continues an additional 1.2 mi into the bay (see Figure 2-18).

Aquatic species and habitats associated with the discharge from CREC have been characterized historically from CREC operations (Stone and Webster Engineering Corporation 1985), and were again sampled from April through November 2008. The extent of seagrass beds has been surveyed beginning in the early 1990s as a part of quantifying recovery of the CREC offshore Gulf of Mexico habitats following installation of helper cooling towers (MML 1993, 1994, 1995). Previously affected seagrass areas nearest the CREC discharge were observed to recover with 50-percent bottom coverage by colonization by shoal grass (*Halodule wrightii*), a dominant, quick-growing seagrass. However, between 1995 and 2001, overall seagrass abundance declined, likely from a number of environmental influences such as turbidity, salinity, and storm events (Marshall 2001).

Sediments at the CREC point of discharge (station 3) and in nearshore waters (station 4, 1.4 mi from point of discharge) are dominated by sand and silt (Figure 2-20). Surface salinities at the discharge mouth and nearshore waters ranged between 28.2 and 31.5 pss, with salinities increasing slightly at increasing depths (CH2M Hill 2009b). Average dissolved oxygen generally decreases along the CREC discharge canal from the discharge origin at 6.28 mg/L to 5.05 mg/L at the point of discharge into Crystal Bay. Average dissolved oxygen then increases to 5.61 mg/L in nearshore waters surrounding the point of discharge. Average temperatures at the point of discharge (31.9°C) were 6°C higher than average temperatures recorded 1.4 mi away in nearshore waters during the 2008 sampling events (CH2M Hill 2009b).

Analytical chemistry analysis of water samples taken in September and November 2008 show no significant differences in total organic carbon, dissolved oxygen, ammonia, nitrate, nitrite, total nitrogen, organophosphate, total phosphate, chlorophyll a, or total suspended solids between the point of discharge and 1.4 mi away in nearshore waters.

Biological sampling at stations 3 and 4 was conducted at multiple time points from April to November 2008. Methods similar to those described for sampling the CFBC were used for sampling the CREC discharge area. Benthic infauna were dominated by polychaete worms, which composed 85 percent of the mean total and 40 percent of the species for both stations. Total density of infauna collected was highest at station 3 during the April sampling, but became higher at station 4 during the November sampling primarily due to increased abundances of gastropods and polychaetes (CH2M Hill 2009b). Motile macroinvertebrates were collected by trawl and crab-trap methods and indicated a greater abundance of stone crabs (*Menippe mercenaria*) (84 percent) over blue crabs (15 percent) and a greater overall abundance at station 4 versus station 3 (CH2M Hill 2009b).

Sampling for zooplankton was carried out as described for the CFBC sampling. Unlike results in the CFBC, meroplankton were the most abundant of zooplankton collected, making up 67 percent of total mean abundance compared with 32 percent for holoplankton and 1 percent

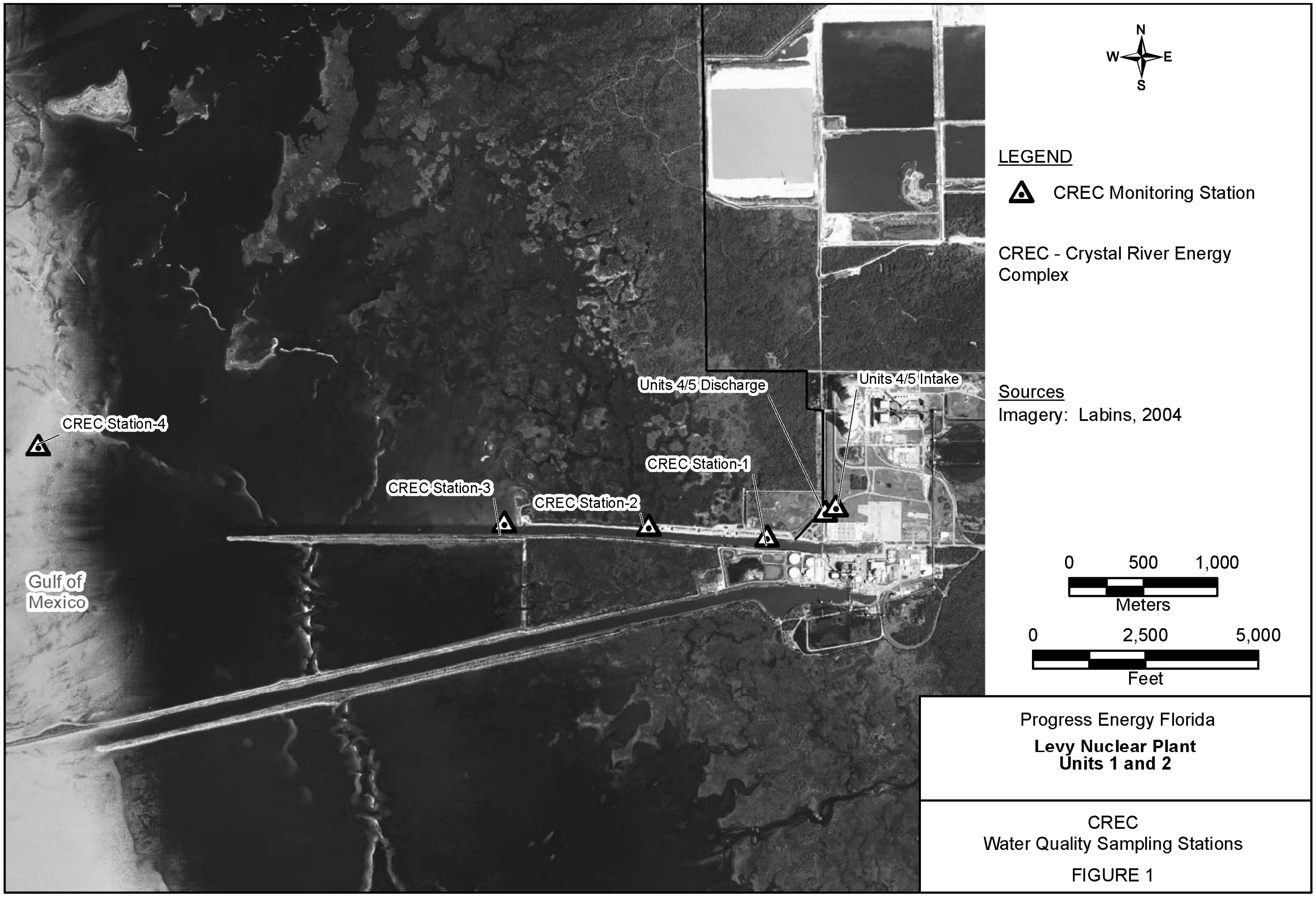


Figure 2-20. Aquatic Sampling Locations for CREC (CH2M Hill 2009b)

for ichthyoplankton. Meroplankton abundance increased with distance from the CREC discharge area and was highest in the spring. Panopeidae crab larvae were the most prevalent organisms at both stations, with overall abundance being higher at station 4. Holoplankton were dominated by copepods, with highest abundances observed in the spring and with distance from the CREC discharge. Ichthyoplankton also increased in abundance with distance from the discharge area, were most abundant in the spring, and were dominated by Gobiidae and Engraulidae larvae (CH2M Hill 2009b).

Fish sampling was performed as described earlier for the CFBC sampling events and presented in Table 2-12. Beach seines were used only at station 3 given the proximity to shoreline access. Sampling was performed in May 2008, July 2008, August/September 2008, and November 2008. Killifishes accounted for 60 percent, mojarras 18 percent, silversides13 percent, and sheephead (*Archosargus probatocephalus*) 6 percent of the total catch. Abundances increased steadily from the June sampling event of 49 CPUE to 104 CPUE in the November sampling event (CH2M Hill 2009b).

Gill nets were deployed at both CREC stations in May 2008, June 2008, August/September 2008, and November 2008. Seasonal diversity was apparent in that yellowfin menhaden (*Brevoortia smithi*) was the most abundant species caught, but was only collected during the November 2008 sampling event. Black drum (*Pogonias cromis*), Atlantic thread herring (*Opisthonema oglinum*), and pinfish were the next most abundant fish species collected. Spring and early summer sampling yielded low numbers, but late summer and fall collections increased dramatically. Total abundance between the two stations was relatively equal with the exception of the November 2008 sampling event, which had almost four times the abundance caught at station 4 versus station 3 (CH2M Hill 2009b).

As with CFBC sampling, 10 minnow traps were used at CREC stations 3 and 4 in May, June, September, and November 2008. Pinfish and pigfish (*Orthopristis chrysoptera*) were the most common species collected at 62 percent of the total catch. Spring sampling events had the highest CPUE compared to the rest of the sampling events, with no differences observed between the two stations.

Cast-net sampling was conducted in April, June, August, and November 2008 at both CREC stations 3 and 4. Mullet species (white and striped) accounted for 59 percent of the total catch; however, both stations had overall low CPUE throughout the sampling events, with station 3 having marginally greater abundance than station 4 (CH2M Hill 2009b).

Trawling events in April, June, August, and November 2008 at both CREC stations 3 and 4 indicated dominance of silver perch, pinfish, and spotfin mojarra with 79 percent of the total catch combined. Total CPUE peaked in August, and the highest abundances and diversity were collected at station 4 (CH2M Hill 2009b).

Fish, plankton, and macroinvertebrate sampling results in the CREC discharge area of Crystal Bay are indicative of coastal salt marsh and nearshore species, and show biodiversity commensurate with similar habitat sampling at CFBC stations 3 and 4 (Table 2-10, Table 2-11, and Table 2-12). However, several of the top forage fish species were notably absent (bay anchovy, scaled sardine, and silver perch) from the CREC discharge stations.

Non-Native and Nuisance Species

No aquatic plant species known to be invasive or nuisance species have been observed in the CFBC. The green porcelain crab was observed during handpicking sampling near station 3 in the CFBC and is an invasive species in the Gulf of Mexico (Ray 2005). Sampling at station 1 near the proposed intake in the CFBC indicated an abundance of the false dark mussel and barnacles, both of which are native potential biofouling species that would associate with CWISs (PEF 2009a).

2.4.2.2 Aquatic Resources – Transmission Lines

This section describes commercial, recreational, important, Federally and State-listed threatened, endangered, species of concern, nuisance or invasive species, and designated critical habitats known to occur in or in the vicinity of the transmission-line corridors proposed to connect the LNP switchyard to the PEF electrical grid. Four 500-kV transmission lines are proposed to run adjacent to or within the existing maintained transmission-line corridors for the CREC that run to the proposed Citrus substation, Central Florida South substation, and the CREC 500-kV switchyard, as described in Section 2.2.2 and shown in Figure 2-5.

New corridor segments would be necessary to connect the LNP site to the existing corridors. Connection to the Citrus substation corridor would require clearing within a 7-mi-long and a 1-mi-wide corridor extending from the southern boundary of the LNP site, which would cross the Withlacoochee River bypass channel, CFBC, and the OWR. The existing corridor and new corridor extending to the proposed Central Florida South substation would cross the Withlacoochee River at the border of Citrus and Marion Counties and Two-Mile Prairie Lake (PEF 2009a). Connection of the CREC switchyard to the new Citrus substation would cross existing corridors over estuarine habitat within Crystal Bay. The existing and proposed transmission-line corridors do not cross any designated aquatic critical habitats.

Beyond First Substations

Additional transmission lines extending beyond the first substations to the electrical grid would also be required (Figure 2-5). Two 230-kV lines would extend from the Citrus substation to the existing Crystal River East substation, a 230-kV line would extend from the CREC switchyard to the Brookridge substation, another 230-kV line would extend from the Brookridge substation to the Brooksville West substation, and the last 230-kV line would extend from the existing Kathleen substation to the Griffin substation and then beyond to the Lake Tarpon substation.

Two additional 69-kV lines would be required to support construction at the LNP site and would connect to existing 69-kV lines from the western and the southern boundaries of the LNP site (PEF 2009k).

Corridor segments beyond the first substations include 38 mi of mostly existing corridor from the CREC switchyard to the existing Brookridge substation. Another 3 mi of existing corridor extends from the Brookridge substation to the Brooksville West substation. Although a specific location for the proposed Citrus substation has not yet been finalized, connection to the existing Crystal River East substation would require a new corridor less than 2.7 mi long and 1 mi wide.

Existing corridors are proposed for the transmission lines extending 50 mi from the Kathleen substation to the Griffin substation, and extending west to the Lake Tarpon substation. This corridor crosses the following OFWs: Blackwater Creek, Trout Creek, the Hillsborough River, and Cypress Creek (PEF 2009k). Other waterbodies include Flint Creek, tributaries of Hollomans Branch, Brushy Creek, Rocky Creek, and numerous unnamed intermittent and perennial tributaries of the previously named waterbodies. The existing and proposed transmission-line corridors do not cross any designated aquatic critical habitats.

2.4.2.3 Aquatic Species and Habitats

Important Species and Habitats

Important species include those that are commercially and recreationally important species; Federally listed threatened, endangered, or candidate species; and those species listed by the State of Florida as threatened, endangered, or species of concern that could be affected by plant construction, preconstruction or operational activities. Species that are essential to the maintenance or survival of the above species or critical to the structure and function of the aquatic ecosystem are also included.

Commercial Species

Commercial fisheries allowed in the Gulf of Mexico in offshore Florida waters for Citrus and Levy Counties include black mullet (*Mugil cephalus*), red grouper (*Epinephelus morio*), crevalle jack (*Caranx hippos)*, ladyfish (*Elops saurus*), black grouper (*Mycteroperca bonaci*), gag grouper (*Mycteroperca microlepis*), grunts (family Haemulidae), porgies (family Sparidae), pink shrimp, blue crab, stone crab, and oysters (FFWCC 2009g). All of these species are also considered recreationally important.

<u>Black Mullet</u> (*Mugil cephalus*)

The black mullet (also referred to as the striped mullet), is one of the most prevalent mullet species in the Gulf of Mexico, and it has a worldwide distribution in coastal and estuarine habitats (Futch 1966). Mullet move from inshore areas to offshore waters to spawn from

October to February. Larvae migrate inshore to grassy nursery habitat and reach commercial harvest size in 1 year. Black mullet feed primarily on detritus, small crustaceans, and plankton (Futch 1966). Fished for food and bait both recreationally and commercially, the commercial fishery for black mullet was over 7 million pounds in 2004, primarily harvested with cast nets and small seines due to a net ban in 1995 limiting large-haul seines and gill nets. Black mullet are most abundant off the central and southwestern coast of Florida with more than 74 percent of Florida west coast landings occurring from Tampa Bay to Charlotte Harbor (Mahmoudi 2005). Black mullet were identified at all four sampling stations of the CFBC and in heaviest numbers at station 4, closest to the Gulf of Mexico. Black mullet were also identified at the CREC sampling stations.

Groupers

The red grouper, black grouper, and gag grouper represent some of the largest recreational and commercially important fishes found in Gulf of Mexico waters. Each of these three grouper species may reach up to 3 ft in length and is sought after for human consumption. Spawning seasons vary, with red grouper spawning in mid spring, gag grouper in winter, and black grouper throughout the year. Juveniles inhabit rocky-bottom or nearshore coastal-reef and seagrass habitats and feed on fish and crustaceans for about 3 years before moving offshore. Adult maturity is attained at about 4 to 6 years, and adults are primarily ambush predators. Grouper species are a managed fishery for both commercial and recreational takes using bag and size limits. Commercial fishing occurs by longline while recreational fishing is accomplished by hook and line (FFWCC 2007a). Over 80 percent of landings (almost 8 million pounds) in 2005 for red grouper were commercial with 99 percent coming from the Gulf Coast. Red grouper are managed under Section 303 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSFCMA) (FFWCC 2007a). Although no grouper adults or juveniles were identified during any of the sampling at the CFBC or CREC stations, these fish are caught by recreational anglers in nearshore habitats such as those that occur near the CFBC and CREC.

Crevalle Jack (*Caranx hippos*)

Occurring along both the Atlantic and Gulf of Mexico coasts, crevalle jack are found as juveniles and small adults in estuarine habitats with high-to-moderate salinities. Adults move offshore and reach sexual maturity in 4 to 6 years. Spawning occurs offshore from April to June. Examination of stomach contents indicates crevalle jack feed primarily on other fish species. Over 1 million pounds were harvested in Florida in 2005, with over 68 percent coming from recreational fishing and 69 percent from the Atlantic coast (FFWCC 2006a). Crevalle jacks were identified at CFBC station 2 near the US-19 overpass and at offshore CREC station 4.

Ladyfish (*Elops saurus*)

The ladyfish is primarily a sportfish species, although a commercial fishery does exist in Florida. Larval and juvenile ladyfish seek out brackish nearshore habitats with salinities ranging between 23 and 25 psu, as is seen for segments of the CFBC and the CREC discharge area. Adults also inhabit nearshore areas, but move offshore in the fall for spawning. Ladyfish feed on other fish species. Over 1 million pounds were caught in Florida waters in 2005, with 85 percent coming from commercial harvest and 96 percent in Gulf of Mexico waters (FFWCC 2006b). Ladyfish were identified at all four CFBC sampling stations and in highest numbers at station 3 at the mouth of the CFBC and at offshore CREC station 4.

Grunt Species

Grunt species such as the pigfish can inhabit nearshore seagrass beds and species like the white grunt (*Haemulon plumieri*) primarily occupy offshore habitats with moderate relief. Grunt species feed on benthic crustaceans, worms, crabs, and mollusks. Grunt juveniles are popular bait species. Commercial landings in 2005 were greatest along Florida's Gulf Coast in Dixie and Pinellas Counties. Total landings for Florida in 2005 were over 2 million pounds, with 83 percent coming from recreational fishing. White grunt and pigfish accounted for 89 percent of Florida Gulf Coast landings in 1995, with white grunt being more dominant (FFWCC 2006c). Pigfish were caught in the more downstream portions of the CFBC at stations 3 and 4 and at both CREC sampling stations.

Porgie Species

Pinfish and sheepshead (*Archosargus probatocephalus*) are the most abundant fish in the porgie family found in coastal and estuarine waters off Levy and Citrus Counties. These species inhabit a variety of estuarine and marine habitats and are harvested for bait and human consumption. Spawning takes place offshore in Florida Gulf Coast waters in February and March. Juveniles migrate to estuarine areas in spring and summer (Muncy 1984; FMNH 2009a). Levy and Citrus Counties each estimated over 1000 lb of porgies caught in 2008 (FFWCC 2009b). Pinfish were collected at all stations in the CFBC and CREC discharge area, while sheepshead were collected at the furthest upstream sampling stations 1 and 2 in the CFBC and at the point of discharge station 3 in the CREC.

Pink Shrimp (*Farfantepenaeus duorarum*)

Pink shrimp are abundant off of Florida's Gulf Coast. As juveniles, pink shrimp inhabit grassy estuarine habitats before migrating to waters ranging from 35 to 120 ft deep as adults. Spawning occurs year-round, with peak spawning times in spring, summer, and fall at 13- to 160-ft depths. In 2005, over 17 million pounds of shrimp species were caught in Florida waters; 74 percent from Gulf of Mexico waters. Pink shrimp are primarily harvested off coastal regions south of Tampa Bay, with white and brown shrimp the more dominant shrimp species harvested off the northwestern coast of Florida (FFWCC 2006d). Catch records for 2008 show over 16,000 lb of brown shrimp harvested in Citrus County compared to 830 lb for pink shrimp. However, all three shrimp species are harvested in bulk for bait, and the total catch was substantially higher for Citrus County in 2008 with over 350,000 lb (FFWCC 2009b). Pink shrimp were collected at stations 2 and 3 in the CFBC and at offshore CREC station 4.

<u>Blue Crab</u> (*Callinectes sapidus*)

The blue crab is currently managed by the Gulf States Marine Fisheries Commission for size minimums, gear configurations, and prohibition of exploitation of gravid females (Steele and Perry 1990). Commercial landings in 2006 for Florida exceeded 11 million pounds, with 73 percent originating from the Gulf Coast (FFWCC 2007b). Reproduction occurs year-round in Florida waters, with peak spawning times occurring in lower salinity waters from March through July. Larvae are typically carried offshore and benthic juveniles return to shallow, estuarine and brackish waters (Murphy et al. 2007). Survival and reproduction are positively correlated with habitat quality (Guillory et al. 2001). Blue crab were collected at stations 2 and 3 in the CFBC, but were not evident in significant numbers for either CREC sampling station.

<u>Stone Crab</u>

Two species of stone crab are known to exist along Florida's Gulf Coast. *Menippe adina*, the Gulf stone crab, ranges along Florida's northern Gulf coast to Texas, while *Menippe mercenaria*, or the Florida stone crab, is predominantly found in the Gulf of Mexico along the central and southwestern coast of Florida. The Florida stone crab is the predominant species along the coast of Citrus and Levy Counties. Spawning occurs from spring to fall, and larvae settle in nearshore coastal waters and estuaries. Adults migrate to seagrass beds or rocky substrate in more saline waters. The stone crab fishery is managed by a Gulf of Mexico Fishery Management Plan to regulate this renewable fishery with harvest only of claws greater than 2.75 in. long. Live crabs are returned to the water to regenerate new claws. Additional management of the stone crab fishery includes a passive trap reduction program and prohibition of claw harvesting from gravid females (Muller et al. 2006). As one of the top five fisheries for Florida, 99 percent of stone crab harvest is made from the Florida stone crab (McMillen-Jackson et al. 2006). No stone crabs were collected in the CFBC, but they were present at both CREC stations sampled.

<u>Oysters</u>

Eastern oysters require firm substrate for attachment and this is a limiting factor for settlement of this species. Found in a range of salinities, oysters require salinity conditions higher than 10 psu for successful spawning, which can occur within as little as a month after settling. Most of the oyster harvest for Florida occurs in the panhandle and big bend regions in the Gulf of

Mexico. Landings from 1982 to 1985 averaged 5 million pounds from the Gulf of Mexico, but have since dropped by as much as 60 percent, primarily due to destruction of habitat following hurricane Elena in 1995. The Gulf States Marine Fisheries Commission developed a regional management plan for the oyster fishery that includes construction and placement of culch reefs (artificial reefs made from shells of clam and oyster) to enhance habitat, gear and catch restrictions, and restoration of freshwater flows (FFWCC 2006e). Sampling activities were not designed to collect this species, but they are known to occur in the offshore oyster reef areas and were observed to line the shoreline of the CFBC near the mouth.

Recreational Species

In addition to the species discussed above under commercial species, the following recreational species are found in the vicinity of the CFBC and the CREC.

Spotted Seatrout (*Cynoscion nebulosus*)

The recreational fishery for spotted seatrout is primarily hook and line with regulations in Florida limiting size to between 15 and 20 in., except one fish per person may be over 20 in., and overall take is limited to 5 per person per day (FFWCC 2009c). The fishing season is closed in February, which coincides with the onset of spawning season. Juveniles migrate to seagrass beds although both juveniles and adults have been observed in channel habitats as well. Adults tolerate a wide range of salinities and feed on copepods, shrimp, and fish (Murphy et al. 2006). Spotted seatrout were collected at the offshore CREC station 4.

Cobia (*Rachycentron canadum*)

Angling for cobia is limited to one fish per harvester per day, with a minimum fork length of 33 in. (FFWCC 2009c). Cobia spawn from May to September and overwinter in south Florida waters near the Florida Keys. Larvae migrate to brackish, coastal waters. Cobias dine on portunid crabs, fish, and squid (FFWCC 2006f). No cobias were observed during sampling activities in the CFBC or CREC. However, recreational angling in inland waters off Florida's Gulf Coast indicate that this species may occur in these habitats (NMFS 2009a).

Common Snook (*Centropomus undecimalis*)

The common snook is one of the most popular of Florida sportfish. A specific snook permit is required for recreational fishing, with a bag limit of one per person per day and a slot limit of 28 to 33 in. This fishery is closed from December through February and from May through August, which coincides with spawning season in the summer (FFWCC 2009c). Preferred spawning habitat has been identified at the mouth of coastal rivers and inlets. Snook tolerate a range of salinities with juveniles preferring less saline habitats associated with mangrove swamps, creeks, and even freshwater rivers with good water quality, pilings, rocks, or mangroves for cover and overhanging vegetation. As snook mature, they move into more saline waters in lower estuary habitats (FFWCC 2009d). Snook were caught at station 2 in the CFBC, and a single snook was caught at the CREC station 3 near the point of discharge.

<u>Red Drum</u> (*Sciaenops ocellatus*)

The red drum is another popular sportfish in Florida. Although there are no restrictions on time of year for fishing red drum, a limit of one fish per person per day between 18 and 27 in. is imposed (FFWCC 2009c). Red drums move to deep offshore waters to spawn in the fall and return to nearshore coastal and estuarine habitats where they spend most of their life cycle (FFWCC 2007c). Tidal currents move larvae to nearshore habitats, where they grow rapidly as juveniles during the first 2 years and associate with seagrass habitats with little wave action (Buckley 1984). Red drum were observed in the CFBC near the Inglis Lock and at the offshore CREC station 4.

<u>Flounder</u>

Flounder caught in Gulf of Mexico waters associated with western Florida are primarily of the family Paralichthyidae. A size limit of 12 in. and bag limit of 10 per harvester per day are the only recreational fishing limitations (FFWCC 2009c). Flounder prefer sandy substrate and spawn in offshore waters deeper than 65 ft during the late fall and winter seasons. Larvae are moved inshore by tidal currents. Gulf flounder feed on benthic fish and crustaceans (FFWCC 2006g). Several flounder species were caught at station 4 offshore of the CFBC and one was caught in Crystal Bay near the CREC discharge.

Essential Species

Several other species of interest, including the species listed below, occur near the LNP site and are essential species that are forage fish for many other species and provide critical links in the food web. Therefore, they are important species for Gulf of Mexico estuarine and marine ecosystems.

<u>Silver Perch</u> (*Bairdiella chrysoura*)

Silver perch is an abundant estuarine fish that serves as a prey species for numerous marine predators. Silver perch tolerate a wide range of salinities. Feeding predominantly on copepods as juveniles, the silver perch switches to mysid shrimp and other fish species as they mature (Waggy et al. 2007). Silver perch were abundant at all CFBC stations (except for station 1 near the Inglis Lock) and at the offshore CREC station 4.

Spotfin Mojarra (*Eucinostomus argenteus*)

Spotfin mojarra occur in estuarine habitats, primarily in seagrass beds. Based on recent sampling in the CFBC and CREC, this abundant, schooling fish serves as a forage food for many other fish species. Larvae and juveniles are found from December to June in 16 to 29°C waters with salinities ranging from 19 to 34 psu (Kerschner et al. 1985). Spotfin mojarra were abundant at all CFBC and CREC stations and were even observed at OWR station 8 near the CFBC.

Spot (*Leiostomus xanthurus*)

Spot occupy estuarine and coastal habitats. Juveniles move closer to inshore habitats during the winter and move offshore in late fall as they mature and prepare for spawning activities. The diet of the juvenile and adult spot includes crustaceans, polychaetes, and mollusks (FFWCC 2006h). Spot were collected in the CFBC at stations 2 and 4, and at the offshore CREC station 4.

Bay Anchovy (*Anchoa mitchilli*)

Common along both coasts of Florida, the bay anchovy is an abundant prey species that is also fished for human consumption. Bay anchovy occupy euryhaline, estuarine, and connected freshwater habitats and can tolerate relatively anoxic conditions in pollution-stressed areas. Spawning occurs in waters less than 20 ft deep during the spring and early summer along Florida's Gulf Coast. Juveniles and adults feed primarily on zooplankton, small crustaceans, and detritus (Robinette 1983). Significant abundances of bay anchovy were observed in the CFBC at all stations.

Rare Species

Several fish and shark species are listed by the NMFS as species of concern within the Gulf of Mexico. The Alabama shad (*Alosa alabamae*) is an anadromous species that forages as an adult in Gulf of Mexico waters, but does not enter any freshwater systems along the western coast of Florida (NMFS 2008a). Likewise, although both the saltmarsh topminnow (*Fundulus jenkinsi*) and the ivory bush coral (*Oculina varicosa)* are species of concern for Florida, neither species occurs along the western coast of Florida in the Gulf of Mexico and they are not discussed further (NMFS 2007a; 2009e).

Dusky Shark (*Carcharhinus obscurus*)

The dusky shark can be found in habitats ranging from the surf zone to depths of over 1000 ft, but avoid estuarine environments with low salinities. Migrations are directed by temperature change moving northward up the western Atlantic in the summer and back down toward the

Caribbean and Gulf of Mexico in the fall (NMFS 2009f). During biological sampling activities for the LNP, no captures of dusky shark were reported. Due to habitat preference, the dusky shark is not expected to occur in any of the locations associated with the LNP site (CFBC, CREC, OWR) and will not be considered further.

Largetooth Sawfish (*Pristis perotteti*)

Closely resembling the Federally endangered smalltooth sawfish, the largetooth sawfish is considered extirpated in the United States. Once ranging from Texas to the tip of peninsular Florida in the Gulf of Mexico, the most recent sightings of this species were in the 1940s (NMFS 2009g). During biological sampling activities for LNP, no captures of largetooth sawfish were reported. Due to lack of presence in U.S. waters, the largetooth sawfish is not expected to occur in any of the locations associated with the LNP site (CFBC, CREC, OWR) and will not be considered further.

Night Shark (Carcharhinus signatus)

The night shark is a deep-water shark occupying depths of 900 to 1200 ft during the day and up to 610 ft at night when it feeds on squid, shrimp, and small fish. Caught primarily on longlines, this species has been depleted as incidental takes while fishing for tuna and swordfish (NMFS 2009h). During biological sampling activities for the LNP project, no captures of night shark were reported. Due to habitat preference, the night shark is not expected to occur in any of the locations associated with the LNP site (CFBC, CREC, OWR) and will not be considered further.

Sand Tiger Shark (*Carcharius taurus*)

Sand tiger sharks are found singly or in schools from surf zone down to 75-ft depths along the western Atlantic coast and throughout the Caribbean and Gulf of Mexico. This species is sometimes found in shallow coastal habitats and prefers to occupy the benthic zone where it feeds on rays, squids, crustaceans, and fish. Juveniles in particular are often found in estuarine environments. Like most large pelagic sharks, the sand tiger has a slow rate of maturation and may produce up to two pups every other year once females reach 7 to 10 years of age (NMFS 2009i). No sand tiger sharks were collected during sampling activities in the CFBC, CREC, or OWR. There is one record of recreational catch off of Florida's Gulf Coast in 2004, but not in any other year over the past decade (NMFS 2009b), so the sand tiger shark will not be considered further.

Speckled Hind (*Epinephelus drummondhayi*)

Adult speckled hind occupy 80- to 1300-ft depths characterized by rocky substrate, while juveniles prefer to stay in shallower waters. This species ranges from coastal North Carolina through the northern Caribbean and U.S. Gulf of Mexico. Speckled hind feed on fish, crustaceans, and mollusks, and they spawn in aggregations from May to October (NMFS 2009j). Although no speckled hind juveniles were observed during sampling activities in the CFBC, CREC, or OWR, habitat is present in the offshore areas for the juveniles of this species. Speckled hind have been caught recreationally in inland waters off Florida's Gulf Coast (NMFS 2009c).

Warsaw Grouper (*Epinephelus nigritus*)

Primarily a deep-water grouper, the warsaw grouper is found in waters 180 to 1700 ft deep with bottom relief. Juveniles may occupy more shallow reefs and reach maturity at 9 years of age. Little is known about spawning other than observations that spawning occurs primarily in August and September for Gulf of Mexico populations. Warsaw grouper feed on crustaceans and fish, and are found from coastal Massachusetts, through the northern Caribbean, and into the Gulf of Mexico (NMFS 2009k). During biological sampling activities for the LNP project, no captures of Warsaw grouper were reported. Warsaw grouper have been caught recreationally in inland waters off of Florida's Gulf Coast (NMFS 2009d).

Federally and State-Listed Species

Federal and State-listed species include the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), Florida manatee (*Trichechus manatus latirostris*), loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), Suwannee cooter (*Pseudemys concinna suwanniensis*), gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), elkhorn coral (*Acropora palmate*) and staghorn coral (*Acropora cervicornis*) and are also considered important species according to ESRP Section 2.4.2 (NRC 2000). Discussion of Federal and State-listed species are found in the following section and in Appendix F.

This section describes the Federally and Florida State-listed proposed threatened and endangered aquatic species in the vicinity of the LNP site. Federally and State-listed aquatic species that may occur near the LNP site are listed in Table 2-13. No identified threatened and endangered aquatic species are located along the proposed transmission-line corridors.

Whales

The distribution of endangered whales listed in Table 2-13 is worldwide. While there is no habitat used by these whales immediately offshore of the CFBC or the CREC discharge, the deepwater, eastern Gulf of Mexico may serve as a migratory corridor for finback whales that migrate toward the lower latitudes from subpolar waters during the winter to calve and then migrate back up the coast to higher latitudes during the summer (NMFS 2009l). Blue and

Table 2-13. Federally and State-Listed Aquatic Species that are Endangered, Threatened, and Species of Concern

Scientific Name	Common Name	Federal Status[(a)]	State Status[(b)]	Relevant Waters of Occurrence
		Mammals		
Balaenoptera musculus	Blue whale	FE		Gulf of Mexico
Balaenoptera physalus	Finback whale	FE		Gulf of Mexico
Megaptera novaeangliae	Humpback whale	FE		Gulf of Mexico
Balaenoptera borealis	Sei whale	FE		Gulf of Mexico
Physeter macrocephalus	Sperm whale	FE		Gulf of Mexico
Trichechus manatus latirostris	Florida manatee	FE	SE	Gulf of Mexico/inland rivers
		Reptiles		
Caretta caretta	Loggerhead sea turtle	FT	ST	Gulf of Mexico
Chelonia mydas	Green sea turtle	FE	SE	Gulf of Mexico
Dermochelys coriacea	Leatherback sea turtle	FE	SE	Gulf of Mexico
Eretmochelys imbricata	Hawksbill sea turtle	FE	SE	Gulf of Mexico
Lepidochelys kempii	Kemp's ridley sea turtle	FE	SE	Gulf of Mexico
Pseudemys concinna suwanniensis	Suwannee cooter		SSC	Estuarine/inland rivers from Alafia to Ochlockonee Rivers
		Fish		
Acipenser oxyrinchus desotoi	Gulf sturgeon	FT	SSC	Gulf of Mexico/inland Rivers
Pristis pectinata	Smalltooth sawfish	FE		Gulf of Mexico
		Invertebrates		
Acropora palmata	Elkhorn coral	FT		Gulf of Mexico
Acropora cervicornis	Staghorn coral	FT		Gulf of Mexico

Sources: FWS 2008a; FFWCC 2008; NMFS 2008b

(a) Federal status rankings determined by the FWS under the Endangered Species Act, FE = Federally Endangered; FT = Federally Threatened (FWS 2008a; NMFS 2008b).

(b) State species information provided by the Florida Fish and Wildlife Conservation Commission (FFWCC 2008).

SE = State of Florida Endangered; ST = State of Florida Threatened; SSC = State of Florida Species of Special Concern (FFWCC).

humpback whales are rare in the Gulf of Mexico (NMFS 2009n, o). The exact movement patterns of sei and blue whales are largely unknown (NMFS 1998). Sperm whales are rare in waters less than 984 ft deep. Like most north Atlantic cetaceans, sperm whales migrate down the western Atlantic coast in the winter to waters east and northeast of Cape Hatteras, North Carolina. The migration back to the north starts in the spring with a migration range extending from waters off the coast of Virginia up to the Northeast Channel area.Sightings of sperm whales in the Gulf of Mexico are rare (NMFS 2007b, c). The migration patterns and population structure of humpback whales in the North Atlantic are well known. Humpbacks migrate to Caribbean waters in the winter to calve and migrate up to waters off New England, Canada, and Greenland in the summer to feed (NMFS 2007c). Due to lack of suitable habitat in the vicinity of the LNP site, CFBC, and CREC these whale species are not considered further.

Florida Manatee (*Trichechus manatus latirostris*)

The Florida manatee tolerates a large salinity range, is found in freshwater environments like springs and rivers and in estuarine habitats, and has a year-round distribution associated with peninsular Florida. A long-lived marine mammal, manatees reach sexual maturity at 4 to 7 years, and calve once every 3 years. These herbivores feed on a variety of submerged aquatic vegetation as well as floating and bank vegetation, and they seek out freshwater sources to drink (Smith 1993). In the winter, manatees migrate to warmer waters, which include power-plant thermal outfalls and four major artesian springs along both coasts of Florida (Laist and Reynolds 2005). Dispersion throughout coastal water habitats occurs during warmer months when water temperatures exceed 20°C, with ranges as far up the Atlantic coast as Massachusetts and as far west in the Gulf of Mexico as Texas (FWS 2008b). The Florida manatee northwest Florida population, which includes Citrus and Levy Counties, makes up approximately 12 percent of the total manatee population. Manatees were observed in the CREC discharge area, particularly during the November 2008 sampling events, which is typical for this species as it seeks out thermal refugia in the fall and winter months. Manatees were also observed year round in the CFBC and OWR (CH2M Hill 2009b). Further discussion of manatees and their occurrence near the LNP site and transmission lines and potential for impacts are presented in Appendix F as part of the biological assessment.

Sea Turtles

Four species of sea turtle are listed as Federally and State endangered, with the loggerhead sea turtle listed at both Federal and State levels as threatened. All sea turtles have certain life-history similarities in that females swim ashore to sandy beaches and deposit eggs in nesting pits that are covered to allow incubation. Juveniles hatch, struggle out of the sandy nest, and make their way to their respective ocean habitats. Although there are no sandy coastline habitats in the area of the CFBC or the CREC discharge area, juvenile and adult sea turtles have been found in these vicinities. A brief overview is provided for the sea turtle species, with more discussion of life-history attributes and potential for impacts in Appendix F as part of the biological assessment.

PEF has an ongoing program to monitor the intake canal for the presence of sea turtles, perform rescues for stranded individuals, provide rehabilitation, and release resources when possible. Between 1999 and 2005, 8 loggerhead sea turtles (*Caretta caretta*), 38 green sea turtles (*Chelonia mydas*), 1 hawksbill sea turtle (*Eretmochelys imbricata*), and 92 Kemp's ridley sea turtles (*Lepidochelys kempii*) have been collected at CREC (Eaton et al. 2008). PEF currently has an incidental take permit from NMFS that allows an incidental live take of 75 sea turtles annually, 3 annual causal sea turtle mortalities, and a reporting requirement for non-causal related mortalities of 8 or more within a 12-month period (NMFS 2002).

<u>Loggerhead Sea Turtle</u> (*Caretta caretta*)

Loggerhead sea turtles occur all along the Gulf of Mexico coast in shallow coastal and estuarine waters as well as along the outer continental shelf. In the Gulf of Mexico, loggerhead sea turtles appear to be concentrated along the southern west coast of Florida (NMFS and FWS 2008). They also are abundant, particularly during the summer, throughout the U.S. coast of the Gulf of Mexico. Most sightings of loggerheads off west Florida are within 86 mi of land. Adult female loggerheads nest above the high-tide line and sometimes in vegetation at the top of sandy beaches. In south Florida, nesting may occur from late April (rare) to the beginning of September, with peak nesting activity in June and July. Newly emerged turtles immediately crawl toward the sea, probably orienting toward the reflected light of the moon (Dodd 1988). They remain offshore for 3 to 5 years (NOAA 1989) and are about 1.5 ft long when they return to coastal waters to forage as subadults. Subadult and adult loggerheads are primarily bottom feeders, foraging in coastal waters for benthic mollusks and crustaceans (Plotkin et al. 1993). Between 1999 and 2005, eight loggerhead sea turtles (juveniles, subadults, and adults) were collected in the intake canal or on the bar racks associated with the intakes for CREC Units 1–3 (Eaton et al. 2008). Nearshore Gulf Coast areas along the Florida coast are important habitat for juveniles. Schmid reported captures of 20 loggerheads from spring through late fall south of Cedar Key as a part of a population study between 1985 and 1996 (Schmid 1998).

<u>Green Sea Turtle</u> (*Chelonia mydas*)

Currently, green sea turtles nest from along the southwestern coastline of Florida to the Georgia border and in the northwestern portion of Florida along the panhandle where nests in these areas seem to be gradually increasing every year (FFWCC 2009e). For nesting, females require the high-energy (wave-active), sandy beaches of barrier islands and mainland shores above the high-water line. Upon emergence, hatchlings immediately seek out the shore and open water (NMFS and FWS 1991). Juvenile green sea turtles drift with the prevailing surface-water currents until they reach a size of 12 to 16 in. at 1 to 3 years and then return to shallow coastal waters, where they spend most of their lives in shallow benthic feeding grounds. A study in 1955 collected 43 juvenile green sea turtles in the Cedar Key area extending southward along the Levy and Citrus County coastal areas including Crystal Bay (Carr and Caldwell 1955).

Another sampling project collected 10 subadults along seagrass shoals from June to September in the Waccassassa Bay area over a 12-year period from 1985 to 1996 (Schmid 1998).

Leatherback Sea Turtle (*Dermochelys coriacea*)

Leatherback sea turtles are a largely pelagic species, but also forage in coastal waters. Juveniles and adults feed throughout the water column to depths of at least 3900 ft (NMFS 2009p), consuming jellyfish and other gelatinous zooplankton, such as salps, ctenophores, and siphonophores (Salmon et al. 2004). Only a small fraction of the Gulf of Mexico and North Atlantic leatherback populations nest on beaches of the continental United States, mostly in Florida and the U.S. Virgin Islands (Bjorndal et al. 1994). Nesting occurs from April to July. Little is known about the behavior or distribution of hatchling and juvenile leatherback sea turtles. Leatherback nests are rare north of Sarasota County and east of the panhandle on the western coast of Florida (FFWCC 2009f). No leatherback sea turtles have been collected in the intake canal or on the intake bar racks at CREC.

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Hawksbill sea turtles show a high fidelity to their nesting beaches and return to the same or a nearby beach year after year. There have only been a few verified reports of hawksbill sea turtles nesting in south Florida, mostly on the east coast. Juveniles and subadults tend to remain and feed on coral reefs near their natal beaches. Hatchling hawksbills congregate in Sargassum rafts to feed and grow for a year or more after emerging from the nest (NMFS and FWS 1993). While in the Sargassum rafts, they consume pelagic fish eggs and larvae, small invertebrates associated with the floating algae, and the Sargassum itself. Subadults and adults are omnivorous scavengers. They seem to have a preference for benthic invertebrate prey, particularly sponges and biofouling organisms (Meylan 1999). Because of their food preferences, they tend to be most abundant in shallow coral- and rocky-reef habitats. These habitats are rare in the northern Gulf of Mexico, accounting in part for the rarity of hawksbill sea turtles in the region. Only one hawksbill sea turtle was collected over the three studies previously mentioned off Citrus and Levy Counties in the Gulf of Mexico; none has been reported at CREC (Eaton et al. 2008; Carr and Caldwell 1955; Schmid 1998), and they are considered rare in these coastal areas throughout the U.S. Gulf of Mexico coastal areas (NMFS 2009m).

Kemp’s Ridley Sea Turtle (*Lepidochelys kempii*)

Nearly all reproduction of Kemp’s ridley sea turtles takes place along a single 9.3-mi stretch of beach near Rancho Nuevo, Tamaulipas, Mexico, about 200 mi south of Brownsville, Texas (Marquez 1994). Hatchlings migrate rapidly down the beach and out to sea where they spend a period of perhaps 2 years in the pelagic zone. During the pelagic period, they presumably feed on zooplankton and floating matter, including Sargassum weed and the associated biotic community. After a pelagic feeding stage shortly after hatching and lasting for several months, the juvenile ridleys move into shallow coastal waters to feed and grow. The young subadults often forage in water less than 3 ft deep, but they tend to move into deeper water as they grow. Ridley sea turtles are found mainly in the Gulf of Mexico, with the northern and northeastern Gulf of Mexico being prime foraging areas for juvenile, subadult, and post-nesting female ridleys (Marquez 1994). They often are observed associated with portunid crabs (*Callinectes* spp.), their favorite prey. Although Kemp's ridley sea turtles nest exclusively on beaches in Mexico (Marquez 1994), juveniles of this species are caught frequently along the coastal areas of Levy and Citrus Counties. The Waccassassa Bay study from 1985 to 1996 collected 269 Kemp's ridley sea turtles (Schmid 1998), and 25 were collected in 1955 (Carr and Caldwell 1955). The latter two studies indicate that as subadults this species uses the oyster reef and seagrass habitats for foraging activities. Since 1999, 99 live takes, 11 CREC non-causal mortalities, and 5 CREC causal mortalities have been reported in the CREC intake canal (PEF 2001 ; PEF 2003; PEF 2004; PEF 2005; PEF 2006; PEF 2007; PEF 2008b; PEF 2009e; PEF 2010)

<u>Suwannee Cooter</u> (*Pseudemys concinna suwanniensis*)

The Suwannee cooter is a freshwater Florida species of concern that inhabits freshwater rivers from Hillsborough to Gulf Coast Counties and estuarine habitats at the mouths of coastal rivers along the Gulf of Mexico (FNAI 2009). Although prevalent in many river systems, this species is susceptible to degradation of nesting habitat along river and stream banks and to water quality. As with most basking turtles, mating takes place in early spring followed by nesting from May to June on high banks or berms along freshwater rivers and streams. Mostly herbivorous, the Suwannee cooter feeds on aquatic vegetation (Ward and Jackson 2008). No observations or collections of Suwannee cooter were noted during the year of sampling in the OWR or the CFBC (CH2M Hill 2009b); therefore, this species will not be considered further.

<u>Gulf Sturgeon</u> (*Acipenser oxyrinchus desotoi*)

The gulf sturgeon has been jointly managed and listed as a threatened species by NMFS and FWS, with NMFS managing the nearshore and offshore habitat range and FWS managing inland from river mile zero. Historically, the range for this anadromous sturgeon extended from Louisiana to south of Tampa Bay, Florida, where it feeds in the Gulf of Mexico and returns to freshwater for spawning. The current range is limited to the Mississippi River east to the Suwannee River, Florida, where the Suwanee River supports the largest subpopulation of gulf sturgeon (Carr et al. 1996). Critical habitat for Florida nearest to the LNP site 8 mi to the north of the CFBC and is designated for 182 mi of the Suwannee River, 12 mi of the northern Withlacoochee River (not connected to the lower Withlacoochee River in the vicinity of the LNP site) where it branches off to the north of the Suwannee River, and 211 mi^2 of estuarine/marine area of Suwannee Sound, which is north of Cedar Key (68 FR 13370). Gulf sturgeon show a high homing fidelity (site-specific) spawning behavior based on gene flow between river drainages (Stabile et al. 1996). Male gulf sturgeon mature in 7 to 9 years and females mature in

8 to 12 years (Huff 1975). Spawning occurs in the Suwannee River when temperatures range between 17 and 22°C in late March to mid-April and the substrate is characterized as clean gravel-cobble mix over rock with strong, persistent laminar flows and eddies that created reversed or diminished bottom currents. Young-of-the-year sturgeon disperse widely downstream of spawning habitats within the river, inhabiting open sandy areas away from shorelines and vegetation (Sulak and Clugston 1998). Juvenile and adult gulf sturgeon typically out-migrate to the marine environment, although some populations tend to hold over in brackish water for a period up to 2 months before moving into the open Gulf of Mexico (Carr et al. 1996). There are no known spawning populations associated with river systems south of the Suwannee River along the Florida coast, and estuarine/marine critical habitat for the gulf sturgeon does not occur south of Cedar Key. No gulf sturgeon were observed or collected during the sampling events described in Section 2.4.2.1 for the CFBC, OWR, or CREC discharge area (CH2M Hill 2009b). More discussion of the potential impacts of the LNP site is provided in Appendix F under biological assessment.

<u>Smalltooth Sawfish</u> (*Pristis pectinata*)

The smalltooth sawfish is a cartilaginous fish, closely related to sharks and rays, that inhabits coastal inland shallows with muddy or sandy substrate where it feeds on benthic fish and crustaceans. Once prevalent from the Atlantic U.S. coast through the Gulf of Mexico to Texas, it is currently found only near the southern tip of Florida (Simpfendorfer and Wiley 2006), which supports an actively spawning population. Still under review, critical habitat designation is proposed to protect this population from Charlotte Harbor to Florida Bay (73 FR 70290), because site fidelity has been observed for this species. Observations of smalltooth sawfish north of Port Charlotte are rare, but two sightings in the coastal Florida panhandle region have been documented since August 2008 (FMNH 2009b). Since 2000, four smalltooth sawfish juveniles have been either caught or sighted offshore of Citrus County; one at the mouth of the CFBC and another just outside the CREC discharge canal (FMNH 2009b). However, no smalltooth sawfish were observed or collected during the sampling events described in Section 2.4.2.1 for the CFBC, OWR, and CREC discharge area (CH2M Hill 2009b). More discussion of the potential impacts of the LNP site is provided in Appendix F under biological assessment.

<u>Corals</u>

Both staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata*) corals are Federally endangered reef-building corals found primarily along the Atlantic coast of Florida and the Caribbean. Designated critical habitat for these two species was established in November 2008, and areas off coastal Florida for Palm Beach, Broward, Miami-Dade, and Monroe Counties are listed. There are no known occurrences of either staghorn or elkhorn coral in Florida Gulf of Mexico waters north of Sanibel Island (73 FR 72210), and therefore, these species will not be discussed further.

1 Table 2-14 lists important species identified by the U.S. Nuclear Regulatory Commission (NRC) staff that are expected to occur in the vicinity of the CFBC and CREC point of discharge and could be affected by construction and/or operation of the LNP.

Table 2-14. Important Species and Likelihood of Occurrence in Waters Associated with Construction and Operation of LNP Units 1 and 2

		Occurrence			
Species	**Category**	**CFBC**	**OWR**	**Crystal Bay**	**Transmission Corridors**
Black mullet	Commercial/recreational	Observed	May occur	Observed	May occur
Red grouper	Commercial/recreational	May occur	Not likely	May occur	May occur
Crevalle jack	Commercial/recreational	Observed	May occur	Observed	May occur
Ladyfish	Commercial/recreational	Observed	May occur	Observed	May occur
Black grouper	Commercial/recreational	May occur	Not likely	May occur	Not likely
Gag grouper	Commercial/recreational	May occur	Not likely	May occur	Not likely
Grunts	Commercial/recreational	Observed	May occur	Observed	May occur
Porgies	Commercial/recreational	Observed	May occur	Observed	May occur
Pink shrimp	Commercial/recreational	Observed	may occur	Observed	May occur
blue crab	Commercial/recreational	Observed	May occur	Observed	May occur
stone crab	Commercial/recreational	May occur	Not likely	Observed	May occur
oysters	Commercial/recreational	Observed	Not likely	Observed	May occur
Spotted seatrout	Recreational	Observed	May occur	Observed	May occur
Cobia	Recreational	May occur	May occur	May occur	May occur
Common snook	Recreational	Observed	May occur	Observed	May occur
Red drum	Recreational	Observed	May occur	Observed	May occur
Flounder	Recreational	Observed	Not likely	Observed	May occur
Silver perch	Essential	Observed	Not likely	Observed	May occur
Spotfin mojarra	Essential	Observed	Observed	Observed	May occur
Spot	Essential	Observed	Not likely	Observed	May occur
Bay anchovy	Essential	Observed	Observed	Observed	May occur
Saltmarsh topminnow	Rare	Not likely	Not likely	Not likely	Not likely
Ivory bush coral	Rare	Not likely	Not likely	Not likely	Not likely
Dusky shark	Rare	Not likely	Not likely	Not likely	Not likely
Largetooth sawfish	Rare	Not likely	Not likely	Not likely	Not likely
Night shark	Rare	Not likely	Not likely	Not likely	Not likely
Sand tiger shark	Rare	Not likely	Not likely	Not likely	Not likely

Table 2-14. (contd)

Species	Category	Occurrence			
		CFBC	OWR	Crystal Bay	Transmission Corridors
Speckled hind	Rare	Not likely	Not likely	May occur	Not likely
Warsaw grouper	Rare	Not likely	Not likely	May occur	Not likely
Blue whale	Federal/State status	Not likely	Not likely	Not likely	Not likely
Finback whale	Federal/State status	Not likely	Not likely	Not likely	Not likely
Humpback whale	Federal/State status	Not likely	Not likely	Not likely	Not likely
Sei whale	Federal/State status	Not likely	Not likely	Not likely	Not likely
Sperm whale	Federal/State status	Not likely	Not likely	Not likely	Not likely
Loggerhead sea turtle	Federal/State status	May occur	May occur	Observed	May occur
Green sea turtle	Federal/State status	May occur	May occur	Observed	May occur
Leatherback sea turtle	Federal/State status	Not likely	Not likely	Not likely	Not likely
Hawksbill sea turtle	Federal/State status	May occur	May occur	Observed	May occur
Kemp's ridley sea turtle	Federal/State status	May occur	May occur	Observed	May occur
Suwannee cooter	State status	May occur	May occur	Not likely	May occur
Gulf sturgeon	Federal/State status	May occur	May occur	May occur	May occur
Smalltooth sawfish	Federal/State status	May occur	May occur	May occur	Not likely
Elkhorn coral	Federal/State status	Not likely	Not likely	Not likely	Not likely
Staghorn coral	Federal/State status	Not likely	Not likely	Not likely	Not likely

Sources: FWS 2008a; NMFS 2008b; FFWCC 2008; PEF 2009a.

Critical Habitats

There are no critical habitats designated by the NMFS or FWS in the vicinity of the LNP site, or crossed by transmission-line corridors. The gulf sturgeon critical habitat occurs on the Gulf Coast of Florida in the Suwannee River and the immediate offshore area and are described further under the Federally and State-listed species subheading for gulf sturgeon (68 FR 13370). Critical habitat for the smalltooth sawfish of over 220,000 ac of coastal habitat in the Charlotte Harbor estuary and over 619 coastal ac in the Ten Thousand Islands/Everglades region of Florida Bay are currently under review for designation and are described further under the Federally and State-listed species subheading for smalltooth sawfish (73 FR 70290). Critical habitat for the Florida manatee closest to the LNP site includes Crystal River and its headwaters known as Kings Bay in Citrus County (41 FR 41914). Because there are no aquatic critical habitats likely to be affected by the proposed LNP or associated offsite facilities and transmission-line corridors, further discussion is not warranted.

Essential Fish Habitats

Essential fish habitat is defined as the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. The 1996 amendments to the Magnuson-Stevens Act (16 USC 1801 et seq.) identified the importance of habitat protection to healthy fisheries. Identifying essential fish habitat is an essential component in the development of fishery management plans to evaluate the effects of habitat loss or degradation on fishery stocks and take actions to mitigate such damage. The CFBC and CREC discharge area of the Gulf of Mexico are designated as Ecoregion 2 by the Gulf of Mexico Fisheries Management Council; the region extends from Tarpon Springs north to Pensacola Bay, Florida (NOAA 2004). Estuarine and marine essential fish habitats have been designated by NMFS in the CFBC and immediate nearshore Gulf of Mexico near the CREC discharge and CFBC for species listed in **Table 2-15**. There are no habitat areas of particular concern near the CREC discharge area or the CFBC. Further discussion is presented in the Essential Fish Habitat Assessment in Appendix F.

2.4.2.4 Aquatic Monitoring

This section describes the analysis and evaluation of PEF's preapplication monitoring programs.

At the proposed LNP discharge location, a current NPDES permit (FL0000159) for CREC Units 1, 2, and 3 requires seasonal flow restrictions and stock enhancement/replacement of aquatic species (red drum, spotted seatrout, pink shrimp, striped mullet, pigfish, silver perch, blue crab, and stone crab) for compliance with Clean Water Act Section 316(b) (PEF 2008c). There are no requirements in the current NRC operating license for current CREC Unit 3 to monitor aquatic resources, including specific aquatic ecological monitoring of the algal community, benthic invertebrates, or fish (AEC 1973). However, PEF has conducted a year of sampling events for the CFBC and CREC discharge area to characterize the aquatic communities in both of these areas (CH2M Hill 2009b).

From October 2007 to November 2008, four stations in the CFBC were sampled extending from the Inglis Lock downstream to the mouth of the CFBC at the Gulf of Mexico and offshore of the mouth of the CFBC. Two stations associated with the CREC discharge were also sampled to establish background data on aquatic communities at the point of discharge into Crystal Bay, and offshore of the point of discharge from April 2008 to November 2008 (Figure 2-20). These six stations were sampled for motile macroinvertebrates, plankton, invertebrates, and fish.

Water quality in the CFBC was assessed during multiple sampling events from October 2007 to October 2008. Mineral concentrations, dissolved oxygen, carbon, temperature, salinity, pH, dissolved solids, and suspended solids were measured (CH2M Hill 2009b).

Table 2-15. Estuarine Essential Fish Habitat Species for the CFBC and CREC Discharge Area

Fishery Management Plan	Species	Common Name	Potentially Affected Life Stage
Coastal migratory pelagic	*Scombermorus maculatus*	Spanish mackerel	Eggs, juveniles, adults
Reef fish	*Lachnolaimus maximus*	hogfish	Juveniles
Reef fish	*Lutjanus apodus*	schoolmaster	Eggs, larvae, juveniles
Reef fish	*Seriola fasciata*	lesser amberjack	Eggs, larvae
Reef fish	*Seriola dumerili*	greater amberjack	Eggs, larvae, juveniles
Reef fish	*Diplectrum bivittatum*	dwarf sand perch	juveniles
Reef fish	*Lutjanus griseus*	gray (mangrove) snapper	Eggs, larvae, juveniles, adults
Reef fish	*Lutjanus jocu*	dog snapper	Eggs, larvae, juveniles
Reef fish	*Lutjanus synagris*	lane snapper	Eggs, larvae, juveniles
Reef fish	*Ocyurus chrysurus*	yellowtail snapper	Eggs, juveniles, adults
Reef fish	*Rhomboplites aurorubens*	vermillion snapper	Juveniles
Reef fish	*Lutjanus campechanus*	red snapper	adults
Reef fish	*Epinephelus morio*	red grouper	Juveniles, adults
Reef fish	*Mycteroperca bonaci*	black grouper	Juveniles, adults
Reef fish	*Mycteroperca microlepis*	gag grouper	Juveniles
Reef fish	*Epinephelus striatus*	Nassau grouper	Eggs, larvae, juveniles
Reef fish	*Epinephelus adscensionis*	rock hind	Eggs, larvae
Red drum	*Sciaenops ocellatus*	red drum	Larvae, juveniles, adults
Shrimp	*Litopenaeus setiferus*	white shrimp	Larvae, juveniles
Shrimp	*Farfantepenaeus duorarum*	pink shrimp	Eggs, larvae, juveniles, adults
Stone crab	*Menippe mercenaria*	Florida stone crab	Eggs, larvae, juveniles

Source: NMFS 2008b.

Water quality in the CREC was measured at stations 3 and 4, and at two additional stations within the CREC discharge canal structure. Mineral concentrations, carbon, dissolved oxygen, temperature, pH, salinity, dissolved solids and suspended solids were measured in September and November 2008 (CH2M Hill 2009b).

The OWR stations were established to provide additional information about aquatic communities occurring between the Inglis Dam and the CFBC in the OWR. Water-quality samples were collected in June and August 2008, while biological sampling was conducted over a 3-month period from May to July 2008.

As part of the State of Florida's Conditions of Certification, "[p]re-operational surveys and monitoring shall be conducted for a period of time to be determined by statistical analysis in coordination between the FWC and the Licensee in order to establish seasonal/climatological baseline, biological and water quality conditions" (FDEP 2010a). PEF will submit a CFBC and Withlacoochee River Survey and Monitoring Plan to the State for approval prior to initiation of formal monitoring.

2.5 Socioeconomics

This section describes the characteristics of the 50-mi region and the three-county local area of greatest economic impact surrounding the LNP site, including demographics, economics, and community characteristics that form the basis for the review team's assessment of the potential social and economic impacts of building and operating the LNP facility.

The review team examined PEF's ER and verified the data sources used in its preparation by examining cited references and by independently confirming data in discussions with community members and public officials (NRC 2009b). The review team requested clarifications and additional information from PEF where needed to verify data in the ER. Unless otherwise specified in the sections below, the review team has drawn upon verified data from PEF (2009a, c, d, e, h). Where the review team used different analytical methods or additional information for its own analysis, the sections below include explanatory discussions and citations for additional sources.

The baseline discussion considers the entire region within a 50-mi radius of the LNP site, with a focus on Levy, Citrus, and Marion Counties. Also discussed are some baseline data for the emergency planning zone (EPZ) defined by the 10-mi radius and the low-population zone (LPZ) defined by the 3-mi radius (Figure 2-21). The geographic areas defined by the three radii (50 mi, 10 mi, and 3 mi) are shown in Figure 2-21 and Figure 2-22.

Levy County, the location of the proposed LNP units, and adjacent Citrus and Marion Counties are considered to be the Economic Impact Area (EIA) for socioeconomic analyses. This is because (1) the construction, preconstruction, and operations workforces are expected to be drawn primarily from residents of these three counties, including both local residents and in-migrants and, (2) the three counties would receive the majority of any benefits and stresses to community services from the additional workers.

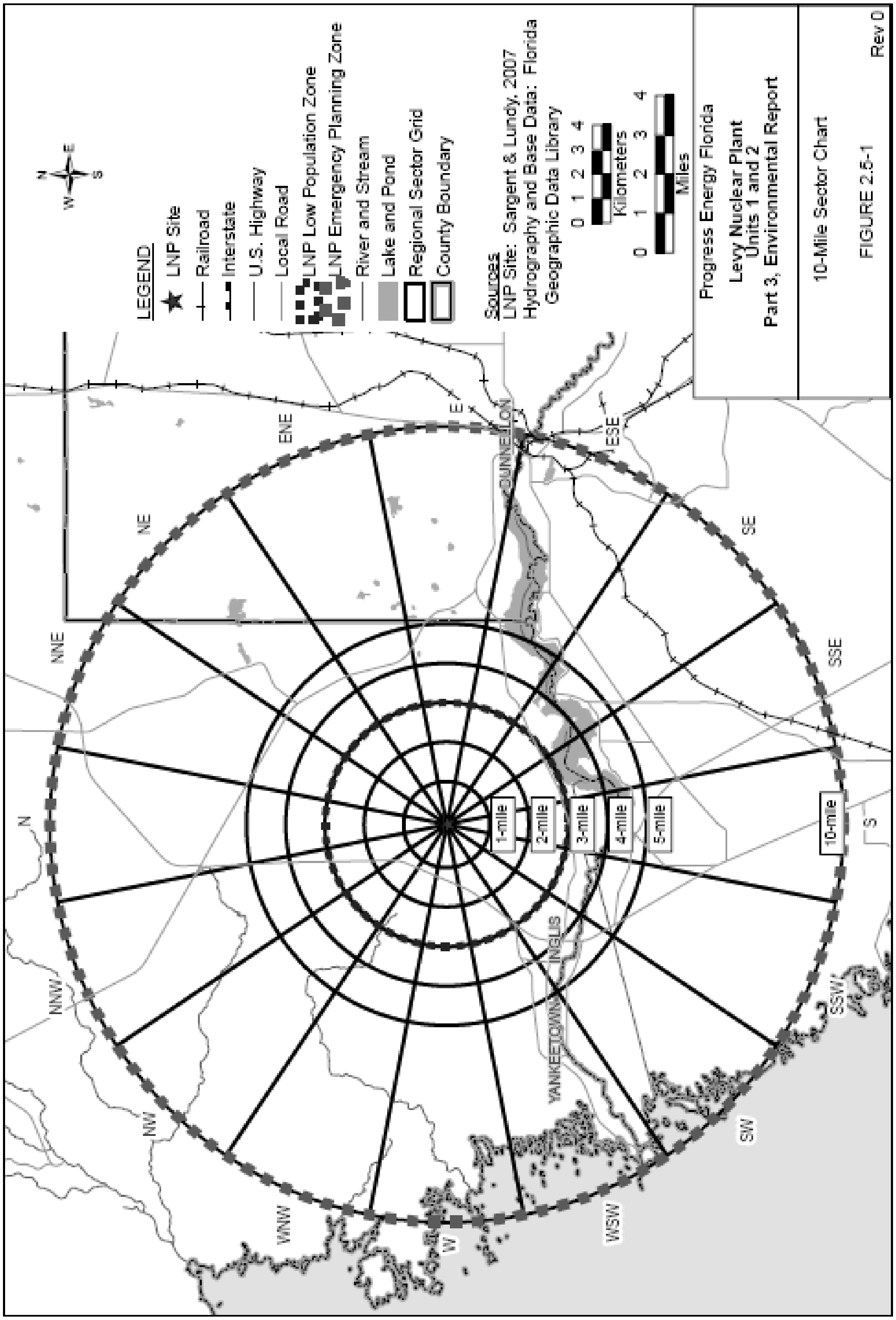


Figure 2-21. 10-Mi Sector Chart (PEF 2009a)

Figure 2-22. Regional Sector Chart (PEF 2009a)

The review team examined the possibility that significant numbers of workers (numbering up to 3300 during the peak construction employment period) may choose to live in a county within 50 mi of the proposed LNP, but outside the three counties. The LNP site has relatively easy access to Gainesville in Alachua County to the north and to portions of four other counties (Hernando, Sumter, Gilchrist, and Dixie as potential areas of residence for proposed LNP construction, preconstruction, and operation workers. Nevertheless, significant socioeconomic impacts are unlikely in these areas, because the population of the Gainesville area is large relative to the size of the workforce, and the accessible communities in the other counties offer little to differentiate them from the communities in the EIA that would be reached in much shorter commute times. Therefore, it is expected that the other counties would receive few workers as residents. Consequently, the remainder of the discussion in this section will concentrate on the three counties of primary interest: Levy, Citrus, and Marion.

2.5.1 Demographics

The review team evaluated the demographic characteristics of resident and transient populations living within the 50-mi region of the proposed LNP. Regional data were gathered by sector; the area within a 3-mi radius of the proposed LNP; and the area within 10-mi radius of the LNP site. The review team has presented these data by county as well as for the EIA. For definitional purposes, “residents” live permanently in the area, while “transients” may temporarily live in the area but have permanent residences elsewhere. Transients are not fully characterized by the U.S. Census, which generally captures only individuals resident in the area at the time of the census.

The data used in this section were derived by PEF from the 2000 Census, other estimates from the U.S. Census Bureau (USCB), the State of Florida, and Warrington College of Business at the University of Florida, Bureau of Economic and Business Research (BEBR). The 2000 census data were used to make comparisons across the region (by sector), among counties, with the State of Florida, and with the United States as a whole. The 2000 census data were used as a baseline and projected to 2080, using growth estimates from BEBR (2006). BEBR provides a projected percent change in Florida county populations in 10-year increments from 2000 to 2030. PEF applied the average of the change rates for the four periods (2000 to 2005; 2000 to 2010; 2010 to 2020; and 2020 to 2030) to generate expected population change rates for 10-year increments between 2030 and 2080. PEF applied the resulting county-level change rates to the census block populations within the 50-mi radius (PEF 2009a). The review team concluded that the approach to demographic analysis performed by PEF was reasonable and that the review team could rely upon it for its analysis.

2.5.1.1 Resident Population

Figure 2-21 presents the geographic boundaries of the 1-, 2-, 3-, 4-, 5-, and 10-mi radial areas extending from the LNP site. Figure 2-22 shows concentric circles in 10-mi increments up to

50 mi from the proposed LNP location. The centers of the circles on these maps are at the midway point between the two proposed reactor buildings (LNP 1 and LNP 2).

In the year 2000, approximately 2 percent of the resident population of the region lived within 10 mi of the LNP site. The remaining 98 percent lived between 10 mi and 50 mi of the LNP site. The resident population within 10 mi of the LNP site is concentrated in and around the communities of Yankeetown to the west-southwest of the LNP site, Inglis to the southwest, and Dunnellon to the east. Within the larger area, the resident population is concentrated around the cities of Gainesville to the northeast, Crystal River to the south, and Ocala to the east. Tables G-1 and G-2 under socioeconomics in Appendix G provide the population distribution among sectors within 10 mi of the LNP site for the year 2000 and projected to 2080, respectively. Tables G-3 and G-4 in Appendix G provide the same data for the population living between 10 and 50 mi of the LNP site. Table 2-16 presents current and projected resident populations by county.

Table 2-17 provides the age and gender distribution of the resident population within the 3 mi, 10 mi, and 50 mi of the proposed site. Gender distribution within the 3 mi exhibited a slightly higher male population, while the 10 mi and the 50 mi exhibited a slightly higher female population. The populations within the 3 mi, 10 mi, and the 50 mi were primarily in the age categories of 5 to 17 years and 40 years and older. Age distribution within the 10 mi exhibited slightly higher percentage (roughly 26 percent) of population 65 and older, when compared to the 3 mi (18 percent) and the 50 mi (23 percent). Within the region, over 40 percent of the total population is 50 years or older. This is an older population compared to the United States as a whole, where only 21 percent of the population was 55 years or older in 2000.

Table 2-18 provides the racial and ethnic distribution of residents within the 3 mi, 10 mi, and 50 mi. Together, African-American and Hispanic residents make up less than 1 percent of the population within the 3 mi, approximately 6 percent of the population within the 10 mi, and 15.8 percent within the 50 mi; all racial and ethnic distributions are less than the national average for minority populations of 37 percent and the Florida State average of 22.1 percent (PEF 2009a).

Table 2-16. Population Projections by County from 2000 to 2080

Geographic Area	Census			Estimates[a]								
	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Alachua	217,955	240,764	260,751	279,666	295,115	308,572	321,090	365,625	416,337	474,083	539,839	614,714
Citrus	118,085	132,635	147,437	161,108	173,576	184,608	195,037	230,768	273,044	323,066	382,252	452,280
Dixie	13,827	15,377	16,973	18,455	19,820	21,039	22,174	25,972	30,421	35,633	41,737	48,886
Gilchrist	14,437	16,221	18,583	20,714	22,734	24,563	26,284	32,124	39,262	47,986	58,649	71,681
Hernando	130,802	150,784	169,976	187,984	204,408	218,903	232,695	282,375	342,663	415,821	504,599	612,331
Lake	210,528	263,017	313,154	359,898	403,774	443,159	480,109	634,704	839,079	1,109,262	1,466,445	1,938,640
Levy	34,450	37,985	42,411	46,466	50,271	53,679	56,861	67,238	79,509	94,020	111,178	131,468
Marion	258,916	304,926	350,923	393,456	433,076	468,346	501,227	625,982	781,789	976,377	1,219,397	1,522,905
Pasco	344,765	406,898	463, 635	517,438	566,673	610,367	650,997	806,325	998,714	1,237,007	1,532,157	1,897,730
Putnam	70,423	73,764	76,957	79,965	82,785	85,309	87,677	94,332	101,491	109,195	117,483	126,399
Sumter	53,345	74,052	92,211	109,294	125,498	140,203	154,116	221,804	319,220	459,421	661,199	951,598

Source: PEF 2009c, which derived data from the Florida Bureau of Economic and Business Research, Warrington College of Business, University of Florida "Estimates of Florida Population, 2006," 2007.

(a) Populations projections for 2040–2080 were based on the average percent growth from four periods 2000–2005, 2000–2010, 2010–2020, and 2020-2030.

Table 2-17. Age and Gender Distribution Within the Region (2000)

	Within 3 mi radius	Within 10 mi radius	Within 50 mi radius
Male	199	8543	429,978
Female	187	8900	454,089
Under 5 yrs	14	735	42,485
5 yr to 17 yr	67	2744	131,631
18 yr to 21 yr	5	540	57,507
22 yr to 29 yr	20	897	79,480
30 yr to 39 yr	40	1890	102,665
40 yr to 49 yr	67	2399	111,079
50 yr to 64 yr	80	3747	153,724
65 yr and older	66	4487	205,491

Source: PEF 2009a, which derived data from the Florida Bureau of Economic and Business Research, Warrington College of Business, University of Florida, "Detailed Population Projections by Age, Sex, Race, and Hispanic Origin for Florida and Its Counties, 2005–2030," 2006.

Table 2-18. Percent Racial and Ethnic Distribution Within the Region (2000)

	African-American	Asian	Native Hawaiian or Other Pacific Islander	Native American	Caucasian	Other	Two or More Races	Hispanic
Within a 3 mi radius	0.0	0.0	0.0	0.0	100	0.0	0.0	0.25
Within a 10 mi radius	3.5	0.6	0.0	0.3	94	0.5	1.1	2.5
Within region	10.8	1.4	0.0	0.4	84.8	1.2	1.4	5.0

Source: PEF 2009a, which derived data from the USCB, "American Factfinder" website, Census 2000 Summary File 1, 100-percent data, Tables P.7 and P.8.

Within the 3 mi, 16.1 percent of the population lived below the poverty level in 1999, which was higher than the national average of 12.4 percent and the Florida state average of 12.5 percent. Individuals below the poverty level in the 10 mi (10.5 percent) and the 50 mi (12 percent) were both lower than the national and State averages. Table 2-19 provides household income data.

Table 2-19. Income Distribution Within the Region – Percent of Households (1999)

	Within 3 mi radius	Within 10 mi radius	Within Region
Less than $10,000	16.1	10.5	12.0
$10,000 to $14,999	12.0	10.5	8.5
$15,000 to $19,999	13.1	10.4	8.7
$20,000 to $24,999	6.2	9.7	9.3
$25,000 to $29,999	9.0	9.8	8.6
$30,000 to $34,999	6.6	7.9	7.8
$35,000 to $39,999	5.8	6.5	6.6
$40,000 to $44,999	5.8	4.1	5.9
$45,000 to $49,999	4.3	4.8	5.1
$50,000 to $59,999	9.4	7.8	8.2
$60,000 to $74,999	5.8	8.1	7.5
$75,000 to $99,999	4.1	4.6	5.9
$100,000 to $124,999	1.1	2.3	2.7
$125,000 to $149,999	0.2	0.9	1.2
$150,000 to $199,999	0.2	1.1	0.9
$200,000 or More	0.4	0.9	1.2

Source: PEF 2009a, which derived data from the USCB, "American Factfinder" website, Census 2000 Summary File 3, Sample data, Table QT-P32.

2.5.1.2 Transient Population

Transients include seasonal or daily workers or visitors to large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, and at recreational areas or special events. Transient population data for the region were obtained from the 2000 U.S. Census, county economic development offices, telephone surveys and interviews, a geographic information system (GIS), and the USDA (Agricultural Census) (PEF 2009d). Table 2-20 provides the baseline transient population information by county for seasonal populations, hotel/motel guests, and migrant workers, as well as recreational area daily capacities for each county in the region.

2.5.1.3 Migrant Labor

The USCB defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from his or her permanent place of residence. The 2002 Census of Agriculture provides the following information on farms, workers, and use of migrant workers in the three counties (USDA 2002). Levy County reported 322 farms and 1013 workers; with use of migrant labor at eight farms. For Citrus County, 55 farms and 245 workers were reported; one farm using migrant labor. Marion County reported 771 farms, 3824 workers; two farms using migrant labor.

Table 2-20 values for migrant workers were estimated by PEF by averaging the number of migrant farm laborers per farm, and then multiplying the average by the total number of farms using migrant farm labor in each county. The review team agreed with this approach.

Table 2-20. Summary of Baseline Transient Populations by County

County in Region	Alachua County	Citrus County	Dixie County	Gilchrist County	Hernando County	Lake County	Levy County	Marion County	Pasco County	Putnam County	Sumter County
Seasonal	1699	12,824	3396	948	8808	16,601	2680	12,982	36,640	7299	5839
Hotel/motel[a]	1425	715	NA	NA	560	450	610	2065	220	NA	275
Recreational areas[b]	4496	8258	0	0	NA	622	4854	2849	0	0	980
Migrant workers	111	5	0	70	67	319	25	10	35	77	56

Source: PEF 2009d.

(a) Hotel/motel information displayed as NA for counties where there were no hotels/motels identified within a 50-mi radius of the LNP site.

(b) Values represent the sum of daily capacities for all recreational areas found in each county.

NA = Not available

2.5.2 Community Characteristics

This section characterizes the communities that may be affected by building and operations activities associated with proposed LNP Units 1 and 2. Seven sections evaluate community characteristics in terms of economy, taxes, transportation, aesthetics and recreation, housing, public services, and education. The review team drew information for this characterization from analysis of PEF's ER (PEF 2009a) and its sources; a technical memorandum assessing community services (CH2M Hill 2009a); and interviews with local officials, agency staff, and residents (NRC 2009b). Information drawn from other sources is cited specifically below.

While all or part of 11 counties fall within a 50-mi radius of the LNP site, three counties (Lake, Pasco, and Sumter) are not included in the economic analysis because less than 2 percent of the land area of each is within 50 mi of the proposed site. The remaining eight counties (Alachoa, Citrus, Dixie, Gilchrist, Hernando, Levy, Marion, and Sumter) therefore define the region addressed in this analysis, with the exception of the aesthetics and recreation analysis, which addresses all 11 counties. Although it discusses effects within the eight-county region, this section focuses on communities in the three counties closest to the site: Levy, Citrus, and Marion. As discussed above, the review team expects these counties to house the majority of workers, both those from the existing local workforce and those who would move into the area to work at the site. Consequently, the effects on community infrastructure and services resulting from building and operation of proposed LNP Units 1 and 2 would be expected to occur primarily in these counties, particularly in the smaller communities that could provide housing for workers within easy commuting distance of the LNP site.

The LNP site is in the southern portion of Levy County. The town of Inglis, at a 4.1-mi driving distance from the site, is the only incorporated area within 6 mi of the LNP site. Yankeetown is about 2 mi west of Inglis or about a 6.5-mi driving distance. Other incorporated municipalities in Levy County, all at a driving distance of 20 mi or more, include Bronson (the County Seat), Cedar Key, Chiefland, Fanning Springs, Otter Creek, and Williston. In Citrus County, Crystal River (at a 15-mi driving distance from the LNP site) and Inverness (the County Seat, 32 mi) are the only incorporated areas, although a number of unincorporated areas have grown since construction of the CREC. Within Marion County, Dunnellon is about 18-mi driving distance from the LNP site, Ocala (the County Seat) is about 36 mi away, and Belleview is about 46 mi; these are the only incorporated municipalities within a 50-mi driving distance. Gainesville, a major city in Alachua County, lies about 50 mi from the site, close to an hour's drive away (City of Wonders 2009; NRC 2009b; Kimley-Horn 2009).

Each county is governed by five elected county commissioners. Yankeetown has a mayor and four city council members. The other municipalities of interest, including Crystal River, Inglis, Dunnellon, Inverness, and Ocala, have a mayor and four or five council members as well as a city manager who implements policy set by the council. Both city council and city manager forms of government have administrative and department staff to carry out city business (City of Wonders 2009).

Levy County is the local planning authority for the LNP site; it controls land use through the Future Land Use element of its Comprehensive Plan (Levy County 2008b). At the regional level, the Withlacoochee Regional Planning Council covers all areas within a 6-mi radius of the site. Portions of the area between 6 and 10 mi from the site fall into four other Regional Planning Councils – North Central Florida, Northeast Florida, East Central Florida, and Tampa Bay. Section 2.2 describes regional and local land-use plans in greater detail.

2.5.2.1 Economy

The economic centers of the 50-mi region are Gainesville in Alachua County and Ocala in Marion County. The two largest employers in the EIA are in Marion County. Marion's top 10 employers include two medical centers, four manufacturers (of wire harnesses, fire equipment, automotive parts, and wire shelving), a trucking company, a defense contractor, a distribution center for a retailer (K-Mart), and a customer-support center for a wireless telephone company. Citrus County's largest employer is PEF's CREC. Other large employers in Citrus County include two hospitals, a boat manufacturer, the county school district, county sheriff's department, two correctional facilities, a business services firm, and a business consulting firm. Levy County's largest employer is the county school board. Other large employers include two construction companies with a total of about 200 employees, a large retailer (Wal-Mart), two manufacturers (of boats and vacuum fittings), a healthcare center, an electric utility (Central Florida Electric Co-op), and a financial holding company (PEF 2009a, which derived data from the Florida Enterprise website, county profile pages).

Table G-5 shows employment and earnings for the region and three counties. Across 1990, 2000, and 2005, construction accounted for roughly 7 to 12 percent of the employment for the region and three counties, slightly less in the region and more in Citrus County. In 2005, construction jobs made up about 10 percent of the jobs in Levy and Marion Counties and about 12 percent of the jobs in Citrus County. Considering heavy and civil engineering construction employment specifically, a snapshot of a week in March 2007 shows about 580 employees in Citrus County, about 390 in Levy, and 1460 in Marion (USCB 2007a). While not all heavy and civil engineering construction is applicable to nuclear plant construction, and some special skills outside this classification will be needed, these numbers show the presence of local workers within the EIA who have skills and experience pertinent to the construction of the proposed LNP units.

Heavy-construction trade categories that might support nuclear power plant construction include supervisors; boilermakers; brick and block masons; carpenters; construction laborers; electricians; lineworkers, insulation workers; ironworkers; millwrights; operating engineers and other construction equipment operators; paving, surfacing, and tamping equipment operators; plumbers, pipefitters, and steamfitters; and welders, cutters, and brazers. Not including assistants and general laborers, 66,200 employees in these trade groups were identified in the northeast Florida non-Metropolitan Statistical Area and the Gainesville, Ocala, and Tampa-St. Petersburg-Clearwater Metropolitan Statistical Areas in 2007 (PEF 2009d, which derived data from the U.S. Bureau of Labor Statistics industry-specific occupational employment statistics for major trade groups within the North American Industry Classification System (NAICS) code 237, heavy and civil engineering construction (PEF 2009d). These four statistical areas include the 11 counties that fall totally or partly within a 50-mi radius of the LNP site, as well as adjacent counties. The review team concluded that these data indicate that there is a large pool of qualified workers from which the proposed project can draw.

Table 2-21 and Table 2-22 show trends in employment and per capita income between 1995 and 2005 in the EIA and the surrounding eight-county region. The EIA generally followed the overall regional trends of a slight decrease in unemployment and increase in per capita income. During the 1995-2005 period, per capita personal income in Florida increased 54.7 percent, from $23,014 to $35,605.

2.5.2.2 Taxes

This section discusses the sources and value of tax revenue that would potentially be affected by building and operating the proposed LNP. It considers sales taxes as well as county property taxes.

The State of Florida collects no personal income tax, but does collect a 6-percent sales tax (FDOR 2010a). In Levy County, vendors collect a 1 percent surtax on each eligible purchase,

Table 2-21. Regional Employment Trends

County	Workers Employed 1995	Workers Employed 2005	Percent Change in Workers Employed 1995-2005[a]	Unemployment Rate 1995, %	Unemployment Rate 2005, %
Alachua	100,469	119,035	18.5	2.9	2.9
Citrus	32,886	48,761	48.3	7.0	4.2
Dixie	3791	5299	39.8	8.5	3.7
Gilchrist	4209	7198	71.0	3.7	3.1
Hernando	41,178	53,891	30.9	5.5	4.8
Levy	12,142	15,829	30.4	4.8	3.7
Marion	87,016	12,098	40.3	5.5	3.7
Sumter	12,376	24,501	98.0	5.5	3.3

Source: BLS 1995, 2005

(a) Percent Change = 100 (x2-x1)/x1, where x2 > x1 (x = variable).

Table 2-22. Regional Per Capita Personal Income (Current Dollars)

County	1995, $	2005, $	Percent Change 1995-2005[a]
Alachua	19,894	31,469	58.2
Citrus	17,447	27,674	58.6
Dixie	13,002	18,514	53.8
Gilchrist	14,847	24,720	71.5
Hernando	18,352	27,036	47.3
Levy	15,121	24,121	59.5
Marion	18,196	28,539	56.8
Sumter	14,073	24,257	72.4
Florida	23,014	35,605	54.7

Source: BEA 2010

(a) Percent Change = 100 (x2-x1)/x1, where x2 > x1 (x = variable).

up to a maximum of $50, which the State distributes back to the county (Levy County 2009). Marion County and Citrus County have no surtax (FDOR 2010b). Florida taxes on gasoline and diesel fuel include statewide taxes of which 3 cents per gallon is returned to the county where it is collected, plus county local option taxes that range from 6 to 9 cents per gallon in the eight-county region. Within the EIA, local option taxes are 6 cents for Citrus and Levy Counties and 7 cents for Marion County (Florida Tax Watch 1999).

Table 2-23 shows that Florida collected approximately $19.8 billion in sales tax revenues in fiscal year 2004–2005, with the eight counties within the 50-mi region responsible for approximately $712 million of this total.

Table 2-23. Total Sales Taxes Collected in the Regional Counties for Fiscal Year 2004–2005

County	Total Sales Tax Collected, $
Alachua	211,972,872
Citrus	86,021,682
Dixie	4,881,881
Gilchrist	3,717,928
Hernando	89,629,394
Levy	19,929,802
Marion	259,007,200
Sumter	36,909,950
Total Region	712,070,709
Florida	19,847,945,740

Source: PEF 2009a, which derived data from the Florida Bureau of Economic and Business Research, Warrington College of Business, University of Florida, "Florida Statistical Abstract, 2006."

The State of Florida also collects a corporate income tax at the rate of 5.5 percent of Florida net income. If a corporation pays Federal alternative minimum tax, it must compute a Florida alternative minimum tax and pay either the latter or the Florida corporate income tax, whichever is greater. The State of Florida offers tax incentives (credit on sales or corporate income tax) to corporations that locate in designated enterprise zones, but PEF has determined that it does not qualify for such incentives, even though the LNP site falls within an enterprise zone (PEF 2009a, which derived data from the Florida Department of Revenue).

The proposed plant site in Levy County makes up the bulk of the property that was acquired for the proposed LNP. Hence of the EIA, Levy County would receive most of the property tax revenues resulting from the project. Table G-6 (PEF 2009a) provides information about tax revenues in the three counties. The discussion below rounds values from the table to the nearest million dollars.

Levy County reported $38 million in revenue in 2006, of which $18 million was from taxes. Intergovernmental revenue provided $10 million. Major Levy County expenditures were for public safety ($16 million), general government ($7 million), and transportation ($6 million). In Levy County, the millage rate applicable to the LNP site in 2008 was 15.78, but the use of the land for forest plantations in 2008 provided an agricultural exemption reducing the assessed value by 90 percent. The Levy County assessor speculated that the millage rate might rise in response to lower property values observed in 2008 (NRC 2009b).

Citrus County revenues in 2006 were $181 million, with ad valorem (property) taxes accounting for $67 million and intergovernmental revenue for $23 million. Personal services ($57 million) and operating expenses ($51 million) were major expenditure categories. Property tax millage rates in 2008 ranged from 16.0852 and 16.1275 in unincorporated areas to 19.4286 in Crystal River and 21.0955 in Inverness (Citrus County Tax Collector 2009).

Marion County 2007 budget data show revenues of $567 million. Of this amount, $196 million was brought forward from the previous year. Property taxes accounted for $130 million and intergovernmental revenue for $48 million. Public safety ($154 million), general government ($119 million), and transportation ($100 million) were major expenditures. Marion County reduced its millage rates for county-wide assessments from 2002 to 2007 (from 6.04 to 3.49 dollars per thousand dollars of assessed value), while county-wide property tax revenue increased over this period (Marion County Budget Department 2007). This illustrates the effect of property value increases on tax income.

The Florida Department of Education calculates millage rates for each county's contribution (the Required Local Effort) to address equalized education funding required by legislation passed in 1973. The 2009 State average Required Local Effort millage rate was 5.288, with Levy and Marion Counties slightly below this (5.253 and 5.230, respectively) and Citrus County slightly above it (5.317) (FDOE 2009a).

2.5.2.3 Transportation

Bus

The bus service closest to the LNP site is part of the Citrus County Transit System, which provides bus service in Citrus County. Transit stops are provided in Crystal River, Dunnellon, and Inverness, among other communities. SunTran and Marion County Transit Services provide public transportation for Ocala and disadvantaged citizens of Marion County, respectively. Greyhound Bus Line provides passenger and freight service between Levy, Marion, and Citrus Counties (PEF 2009a).

Roads/Highways

US-19 is the major highway near the LNP site; it serves as a major north-south route through Levy, Citrus, and Hernando Counties on the Gulf of Mexico, passing through Crystal River, Inglis, and Chiefland. Other north-south routes in the vicinity of the LNP site include CR-121 connecting Williston to Gainesville; US-41, which traverses the cities of Dunnellon, Inverness, and Williston; and US-27, which connects Chiefland to Ocala through the city of Williston. Interstate 75 is east of the proposed LNP in the vicinity of Ocala and is the only interstate within 50 mi of the LNP site. East-west connectors include CR-50 south of the LNP in Hernando County connecting Spring Hill to I-75 through Brooksville, and CR-464 and US-27. Access to the LNP site is via US-19 (west of the site), CR-336 (north and east of the site), and CR-40 (south of the site). An access road from US-19 would be used by all workers to enter and leave the site.

Traffic counts (average annual daily traffic [AADT]) within 5 mi of the proposed LNP ranged from 1600 to 8600 vehicles per day in 2008 (FDOT 2008). US-19 in Levy County and US-27 through Williston are four-lane roads. All other county routes and highways are two-lane roads. The Levy County Comprehensive Plan indicated that some segments of CR-121 and US-41 are expected to meet or exceed capacity by 2010 and that four-lane widening may be needed on a number of road segments within 50 mi of the LNP site (Levy County 2008c). Another recent traffic study determined that intersections (US-19 and SR-121; US-19 and CR-40) and roadway segments (US-19 from SR-121 to the project site; US-19 from the project site to CR-40; US-121 from US-19 to NW 27th Street; US-41 from SE 80th Street/NW 27th Street to CR-328, and CR-40 from US-19 to proposed location of heavy-haul driveway) near the LNP site are currently operating at acceptable LOSs (Kimley-Horn 2009).[(a)]

With the exception of widening the US-19 bridge over the CFBC on US-19 just south of Inglis to four lanes, no other road improvements are scheduled in the vicinity of the LNP site that would affect traffic along area roadways during 2012–2018, the expected period for construction and preconstruction of the proposed LNP. A northward expansion of the Suncoast Parkway into Citrus County could be completed before or soon after the proposed LNP units become operational, but it is not expected to be completed in time to affect conditions during the construction and preconstruction of the LNP site.

The review team’s analysis draws on a traffic study conducted to determine the impacts of the proposed LNP project on the surrounding road network (Kimley-Horn 2009). The Kimley-Horn (KH) study considered the roads likely to be used to transport construction materials and equipment to the LNP site and to transport commuting workers to and from the site. The KH study used AADT counts from 2007 from FDOT and daily counts collected in 2008 by Lincks and Associates to establish existing LOSs along the segments and intersections of concern.

(a) LOS categories range from “A” (free flow) to “F” (stop and go traffic).

US-19 is a four-lane divided highway with an LOS standard of "B." SR-121, CR-40, and US-41 are all two-lane undivided facilities with LOS standards of "C." The KH study found that all were operating within an acceptable LOS performance standard during the peak hours examined.

Railroad

There is no railroad access to the site. CSX Corporation operates the only active railroad line within the 10-mi vicinity of the LNP site. This railroad line runs from the existing CREC through Dunnellon, and heads in a northeasterly direction toward Jacksonville, Florida.

2.5.2.4 Aesthetics and Recreation

The LNP site is characterized by forested land and wetlands surrounded by upland areas. Forested areas are primarily densely planted pine and are managed for timber extraction. Cypress swamps exist in and around the site and rural, low-density residential development characterizes the area surrounding the site, but not within the site.

Within the region, there are 29 State parks, as well as forests, reserves, trails, conservation areas, and marinas (see Table 2-24 and Table 2-25). The State parks closest to the LNP site are Goethe State Forest and Crystal River Preserve State Park. Goethe State Forest offers hunting in some areas in addition to hiking, wildlife viewing, camping, and other opportunities.

Hunting quotas are in place to limit the number of hunters during specific hunt-types (e.g., muzzleloading, rifle, bow) ranging from 130 to 300 per type. Statistics for 2006–2007 hunting reflect usage at three-quarters or less of quota levels. Crystal River Preserve State Park is located along the Florida Gulf Coast and offers bicycle and walking trails, fishing, and waterbodies for canoeing and kayaking (PEF 2009a).

Other popular recreational resources within the region include the Withlacoochee State Forest located south of the LNP site in Citrus County. The Ocala National Forest, located east of the LNP site with 383,220 ac, is more than twice the size of the Withlacoochee State Forest (157,479 ac) and boasts more visitors each year than any other national forest in Florida. Fanning Springs State Park is located on the Suwannee River northwest of the LNP site and is popular because it houses one of Florida's 33 "first-magnitude springs," meaning it discharges at least 100 ft^3 of water per second or roughly 64.6 Mgd. The Homosassa Springs Wildlife State Park, located just south of the Crystal River Preserve State Park, is also a popular recreation destination for viewing wildlife, including endangered species. The Marjorie Harris Carr Cross-Florida Greenway is located south of the LNP site on the border of Citrus and Levy Counties along the St. John's River and offers hiking trails, horse use, bicycling, boating, and other water activities along a 110-mi corridor. Devils' Den and Blue Grotto are two warm-water springs and underground caverns located in Levy County, northeast of the site in the city of Williston. The caverns are open to certified divers (PEF 2009a).

Table 2-24. Recreational Areas Within 50 Mi of the LNP site

Area	Average Daily Attendance	Daily Capacity	Average Percent Use	Projected Capacity	Approximate Distance and Direction to LNP
Cedar Key Museum State Park	56	884	6.3	908	42.3 km (26.3 mi) E
Cedar Key Scrub State Park	46	216	21.3	352	37.5 km (23.3 mi) SE
Crystal River Archaeological State Park	52	488	10.7	588	18.2 km (11.3 mi) N
Crystal River Preserve State Park	748	NA	NA	NA	9.0 km (5.6 mi) NE
Dade Battlefield Historic State Park	51	980	5.2	980	66.5 km (41.3 mi) NW
Devil's Millhopper State Park	122	480	25.4	480	73.2 km (45.5 mi) S
Dudley Farm Historic State Park	44	260	16.9	260	64.8 km (40.3 mi) S
Fanning Springs State Park	770	1010	76.2	1318	63.9 km (39.7 mi) SE
Fort Cooper State Park	68	1018	6.7	1302	41.3 km (25.7 mi) NW
Goethe State Forest	NA	NA	NA	NA	2.6 km (1.6 mi) S
Homosassa Springs Wildlife State Park	895	6464	13.8	6464	30.1 km (18.7 mi) N
Lake Griffin State Park	97	622	15.6	904	73.7 km (45.8 mi) W
Manatee Springs State Park	367	2536	14.5	2544	55.8 km (34.7 mi) SE
Marjorie Harris Cross Carr Florida Greenway	82[(a)]	NA	NA	NA	NA
Marjorie Kinnan Rawlings Historic State Park	55	120	45.8	120	63.2 km (39.3 mi) SW
Ocala National Forest	NA	NA	NA	NA	63.7 km (39.6 mi) W
Paynes Prairie Preserve State Park	533	2820	18.9	2850	57.3 km (35.6 mi) SW
Rainbow Springs State Park	541	1775	30.5	1835	16.9 km (10.5 mi) W
San Felasco Hammock Preserve State Park	157	816	19.2	1616	71.6 km (44.5 mi) S
Silver River State Park	629	1074	58.6	1602	56.7 km (35.2 mi) W
Wacasassa Bay State Park	72	208	34.6	280	9.5 km (5.9 mi) E
Withlacoochee State Forest	1869	NA	NA	NA	22.5 km (14.0 mi) W
Yulee Sugar Mill Ruins Historic State Park	87	288	30.2	288	32.1 km (20.0 mi) N
Total	7346	22,059	25.0	24,691	

Source: PEF 2009a, which derived data from individual park unit management plans and websites from Florida Department Environmental Protection, Division of Recreation and Parks; and the Goethe State Forest website from Florida Department of Agriculture and Consumer Services.

(a) Attendance reported for the portion of the greenway to the west of Lake Rousseau.

NA = Data not available (due to open access in these recreation areas, capacity information is unavailable).

Table 2-25. Total Trail Distances in the Region

County	Trail Distances (mi)[a]	
	Land Trails	Water Trails
Levy	117.14	1.73
Citrus	164.5	33.89
Marion	270.95	16.1[b]
Alachua	110.42	0
Dixie	18.2	32.2
Gilchrist	11.14	45.65[c]
Hernando	101.82	24.1
Lake	9.81	0
Pasco	11.1	1.06
Sumter	51.9	40.03[d]

(a) Source: PEF 2009a, which derived data from the Florida Geographic Data Library, 2007.
(b) Trail is the border between Marion and Citrus Counties.
(c) 16.94 mi of total also borders Dixie County and 28.71 mi of total also borders Sumter County.
(d) 28.71 mi of total also borders Gilchrist County and 11.32 mi of total also borders Hernando County.

There are 35 marinas and 512 recreational vehicle (RV) parks with almost 22,000 hookups in the EIA. Recreational land trails total 867 mi in the 11 counties, 553 mi of which are in the EIA. The RV parks offer places where incoming construction workers might stay. Table 2-26 lists the RV parks in the region and their total capacities. Marion and Citrus Counties have the largest number of RV parks in the 50 mi, or 167 and 86, respectively (PEF 2009a).

Table 2-26. Mobile Home and RV Parks in the Region

County	Total Number	Total Capacity
Levy	35	1752
Citrus	86	6008
Marion	167	14,095
Alachua	29	3244
Dixie	9	276
Gilchrist	4	244
Hernando	43	5310
Lake	33	7105
Pasco	46	4292
Putnam	1	91
Sumter	59	5445
Total	512	47,862

Source: PEF 2009a, which derived data from the Florida Geographic Library.

Figure 2-23 and Figure 2-24 show the locations of the regional parks, recreation areas, conservation areas, and trails within the region.

Figure 2-23. Regional Parks and Recreational Areas (PEF 2009a)

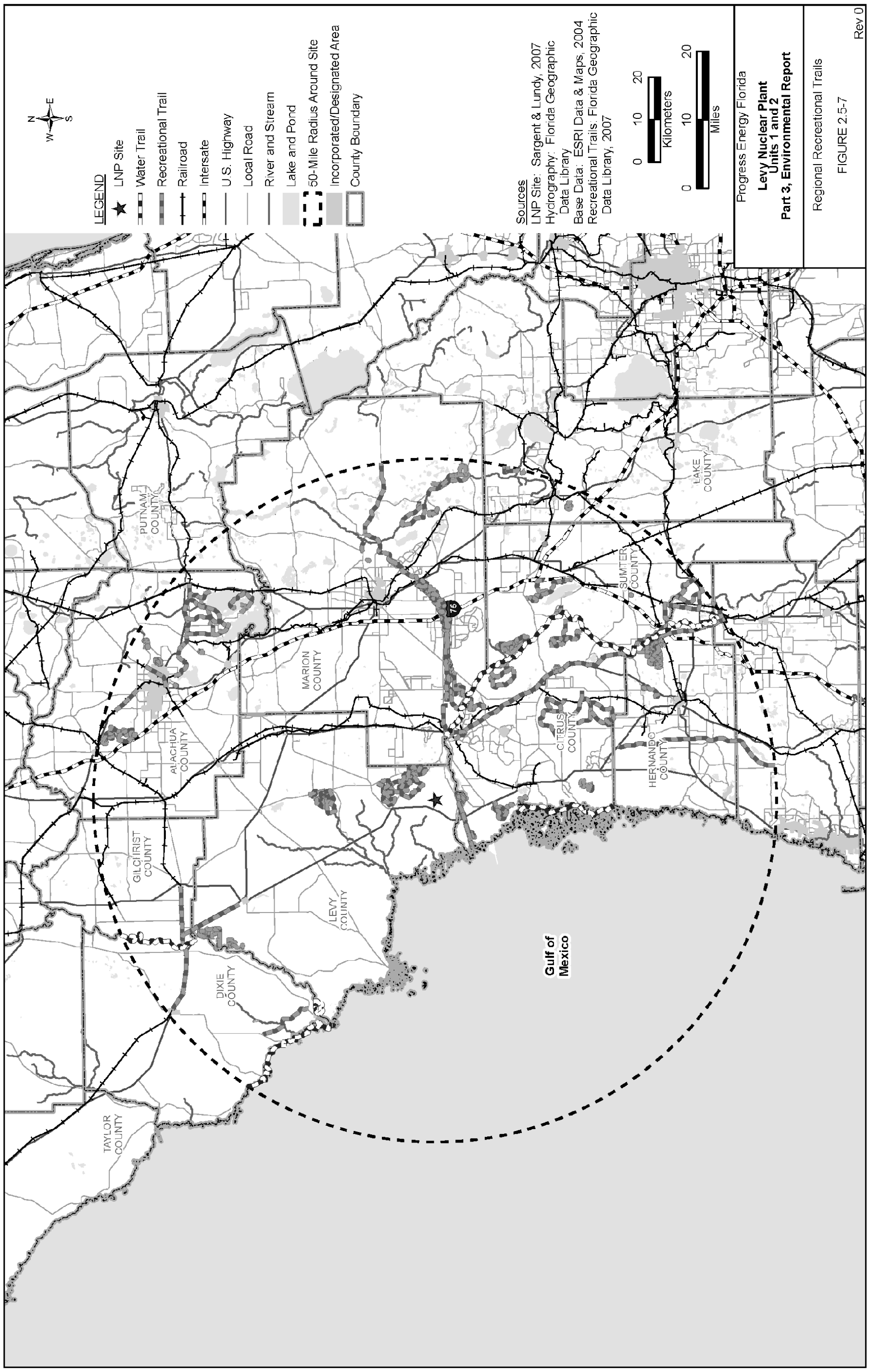


Figure 2-24. Regional Recreational Trails (PEF 2009a)

2.5.2.5 Housing

Existing housing patterns follow development patterns within 50 mi of the site, with residential areas clustered within town and city limits and scattered large-lot development occurring in the surrounding county area, and linearly along transportation corridors. Levy County has fewer housing options than Marion and Citrus Counties. Mobile homes are a primary housing type within the EIA, especially within Levy County, where they account for 70 percent of all dwelling units, according to Levy County planning staff. Near the site, residential options include neighborhoods within Yankeetown, Inglis, Dunnellon, and Crystal River, as well as development along US-19 in the vicinity of the CFBC.

Housing stock and availability in the EIA and the region are presented in Table 2-27. The data in Table 2-27 came from the 2000 U.S. Census, which the review team recognized as an older source of information than other housing data relied upon in PEF's ER. However, the 2000 census data offer a greater level of detail than more recent updates and therefore the review team relied upon the 2000 Census for this analysis. The review team compared the 2000 U.S. Census data to a later study of housing between 2005 and 2007 also performed by the USCB (2007b, c, d) and determined there was no statistical difference between the two sources. Consequently, for comparative purposes between the ER and the EIS, the review team accepted the ER's data for Table 2-27 without update.

Table 2-27. Regional Housing Stock in 2000

County	Total Housing Units	Number Vacant	Percent Vacant	Number Owner-Occupied	Number Renter-Occupied	Percent Renter Occupied
Levy	16,570	2703	16.3	11,591	2276	16.4
Marion	22,663	15,908	13.0	85,183	21,572	20.2
Citrus	62,204	9,570	15.4	45,041	7,593	14.4
Alachua	95,113	7,604	8.0	8,085	39,424	45.1
Dixie	7362	2157	29.3	4498	707	9.6
Gilchrist	5906	885	15.0	4331	690	11.7
Hernando	62,727	7302	41.6	47,970	7456	13.5
Lake	131,140	21,400	16.3	90,246	22,494	17.2
Pasco	212,960	28,296	13.3	142,695	41,969	19.7
Putnam	35,276	7664	21.7	20,903	6709	19.0
Sumter	25,195	4416	17.5	17,972	2807	11.1

Source: USCB 2000

The 2000 U.S. Census data indicate that housing units in Levy County were primarily owner-occupied including those in towns within 10 mi of the LNP site (Inglis and Yankeetown). The 16-percent vacancy rate in Levy County was comparable to the State vacancy rate of 16.7 percent. Marion and Citrus Counties had similar vacancy rates. In 2000, rental units made up nearly 30 percent of the total housing units in the cities of Dunnellon and Crystal River, a higher percentage than in Levy, Citrus, and Marion Counties as a whole. While the majority of houses in the housing stock within the EIA in 2000 were constructed after 1970 and most in Citrus County after 1980, the condition of the housing stock varied. Much of the Levy County housing stock was physically deteriorated. The lower-priced houses and available mobile homes in Citrus County were likely to be older and more deteriorated. A 1990 survey found about 5 percent substandard housing in Citrus County, with concentrations around Crystal River, Inverness, Homosassa, and Floral City; census data for unincorporated areas found about 3 percent substandard housing in 1990 and about 2 percent in 2000 (Citrus County 2008). In Marion County, 4.4 percent of the residential units and 15 percent of the mobile homes were in substandard condition in 2000 (PEF 2009a, which derived data from the Marion County Community Development Block Grant Action Plan 2004/2005).

A 2005–2007 U.S. Census housing study revealed that Levy County had a lower median home value ($106,400) that Citrus County ($141,100) and Marion County ($142,900) (USCB 2007b, c, d).

Temporary housing options and capacity for 2006–2008 are listed in Table 2-28 and Table 2-29. Levy County offers four hotels with a total of 41 available rooms within 10 mi of the site, as well as 15 apartment buildings, 9 rental condominiums, 8 transient apartment buildings, and 35 RV parks. Marion and Citrus Counties offer substantially more short-term housing options.

The review team determined through analysis of PEF's ER and other data sources that neither Native American reservations nor any housing reserved for Native Americans exist within the EIA.

2.5.2.6 Public Services

This section provides information about services provided to the residents of the EIA to address public health and safety in the areas of water and wastewater, police service, fire-protection services, emergency response, and healthcare. Education is covered in Section 2.5.2.7. The review team examined PEF's data and obtained additional information as needed for each of the service areas discussed below and determined that the information presented is reasonable. The review team also reviewed the methodology used by PEF to reach capacity conclusions and determined that PEF's conclusions were also reasonable and that the review team could rely upon those conclusions in this EIS.

Table 2-28. Regional Public Lodgings: Apartments, Rooming Houses, Rental Condominiums, and Transient Apartments in 2006

	Apartment Building		Rooming Houses		Rental Condominiums[a]		Transient Apartment Buildings[b]	
County	Number	Unit	Number	Unit	Number	Unit	Number	Unit
Levy	15	312	1	3	9	118	8	40
Marion	136	7906	0	0	6	100	10	50
Citrus	31	1001	2	9	5	140	11	117
Alachua	394	27,365	3	71	0	0	6	134
Dixie	1	32	1	16	0	0	2	16
Gilchrist	2	60	0	0	1	1	0	0
Hernando	55	2270	0	0	0	0	4	25
Lake	173	8387	5	45	664	1391	9	121
Pasco	149	10,717	2	35	79	910	7	87
Putnam	33	1304	2	33	1	23	1	11
Sumter	16	467	0	0	13	803	4	24

Source: PEF 2009a, which derived data from the Bureau of Economic and Business Research, Warrington College of Business, University of Florida, "Florida Statistical Abstract, 2006."
(a) Rental condominiums include resort condominiums and resort dwellings.
(b) Transient apartment buildings are those which rent for 6 months or less (excludes 270 bed and breakfast facilities with 1812 units).

Table 2-29. Hotels Within 10 Mi of the LNP Site in 2008

County	Total Hotels	Total Rooms Available
Levy	4	41
Citrus	3	208
Marion	3	55

Source: PEF 2009a, which derived data from Google maps and hotel websites.

Water Supply

The review team obtained information about Levy County water supply from supporting data and analyses compiled in the late 1980s and early 1990s, which is still the current supporting document for the infrastructure chapter of the Levy County Comprehensive Plan (Levy County 2008a). Because Levy County bases its current planning efforts on these data and analyses, the review team considered them as a starting point in its own analysis presented below. Most Levy County residents obtain potable water from private wells, although small treatment facilities serve some residential areas, recreation areas, and commercial facilities. Based on data for public and private wells permitted by the two water-management districts that serve the county – SWFWMD and Suwanee River Water Management District (SRWMD – Levy County estimated a total permitted average daily pumpage of 34 Mgd, with maximum permitted daily pumpage of 182 Mgd. These permitted uses are lower than estimates of actual use. The primary water use was agricultural. Estimates from the two water districts for 1985–1990 show total estimated water withdrawals of approximately 18 Mgd, with approximately 15 Mgd agricultural, 2 Mgd domestic, and 1 Mgd for small public treatment facilities (PEF 2009a; SWFWMD 2005, 2006, and 2008; Levy County 2008a, c; SRWMD 2004.)

The county's supporting analysis provided a forecast of residential water consumption from 1995 through 2020 using projected population estimates and a per capita consumption of 150 gpd in 1995 that decreased to 134 gpd in 2020. Results from the analysis showed an increase in projected residential consumption from an estimated 4.34 Mgd in 1995 to 5.53 Mgd in 2020. The analysis applied the same percentage increase to agricultural water use as it projected for residential use, projecting about 20 Mgd for 2020 for a total of about a 25.5-Mgd withdrawal in 2020.

The analysis evaluated Levy County capacity by considering the relationship between projected groundwater withdrawals and the 109 Mgd daily aquifer recharge assumed for the county, finding ample capacity in projected withdrawal of less than one quarter of the daily recharge. The analysts recommended that the Board of Commissioners focus on control of development into unincorporated areas, coordinating with existing cities to allow the Board to extend centralized water systems into unincorporated areas. They noted that existing municipal systems in 1989 had surplus water-treatment capacity. The analysts also recommended that the Board consider requiring a central water system for any planned major development (PEF 2009a; SWFWMD 2005, 2006, and 2008; Levy County 2008a, c; SRWMD 2004.)

The review team applied Levy County's forecast method using more current population figures and projections from Table 2-16. Because the supporting analysis did not provide a basis for reduced consumption estimates over time, the review team retained the 150-gpd per capita estimate throughout the projection period. The review team also retained the assumption that agricultural water use would remain about five times that of residential use, as it was in 1985–1990. Using this approach, the review team projected Levy County needs for residential, agricultural, and total water as listed in Table 2-30.

Using the approach of the analysis supporting the Levy County comprehensive plan, these projections indicate ample water supply in 2020, with withdrawals projected at less than half of the daily recharge to the aquifer in the county.

Table 2-30. Projected Levy County Water Demand from 2000–2020

Year	Population	Residential Consumption at 150 gpd/per person (Mgd)	Agricultural Consumption at 5 × Residential (Mgd)	Total Consumption (Mgd)
2000	34,450	5.17	25.84	31.01
2005	37,985	5.70	28.49	34.19
2010	42,411	6.36	31.81	38.17
2015	46,466	6.97	34.85	41.82
2020	50,271	7.54	37.70	45.24

Sources: PEF 2000a, based on BEBR population forecasts; Levy County 2008a, c; SWFWMD 2005, 2006 and 2008; SRWMD 2004.

The review team obtained information about Marion County water supply from the potable-water subelement of the Marion County Comprehensive Plan (Marion County 2008), the 2006 Regional Water Supply Plan of the SWFWMD (SWFWMD 2006), the 2003 Water Supply Assessment, and the 2005 District Water Supply Plan of the St. Johns River Water Management District (SJRWMD 2006a, b). Marion County owns 41 water facilities and has interlocal agreements with municipalities and franchise agreements with publicly and privately owned public water systems to supply water to its residents. The county projects future needs for water facilities based on its level of service standard of 150 gallons per person per day, with nonresidential demand projected to be 2750 gallons per acre per day. Table 2-31 shows estimated and projected water usage for the county.

Table 2-31. Projected Water Demand for Marion County from 2000–2025

Year	2000[(a)]	2005	2010	2015	2020	2025
Water Use, SJRWMD (Mgd)	45.85	41.84	45.30	48.75	52.21	55.67
Water Use SWFWMD (Mgd)	14.73	19.259	22.163	24.854	27.355	29.578
Total County Water Use (Mgd)	60.58	61.099	67.463	73.604	79.565	85.248

Sources: SWFWMD 2006, SJRWMD 2006b,

(a) The review team noted both districts used population estimates that included consideration of BEBR projections (the basis for Table 2-16 in this document), but used population estimates for 2000 that differed from the totals enumerated in the 2000 U.S. Census. Furthermore, SJRWMD developed its own model for population growth with the district (SJRWMD 2006a).

The review team obtained information about Citrus County water supply from the 2006 regional water supply plan of the SWFWMD (SWFWMD 2006), which serves the entire county; and from the infrastructure chapter of the Citrus County Comprehensive Plan (Citrus County 2008). Historically, most county residents received water from private wells. By the 1980s, prompted by increasing saltwater intrusion into coastal groundwater supplies, the county enacted ordinances to promote establishment of centralized county water services, required that all new potable water facilities be dedicated to the county, encouraged removal of potable-water wells in areas of saltwater intrusion, and required that all new developments connect to the county's water system as soon as service was available. Citrus County relies on the assistance of the Withlacoochee Regional Water Supply Authority and the SWFWMD to identify future water needs and supplies, conceptually, for a 20-year horizon. The SWFWMD estimated that approximately half of the domestic water supply for Citrus County for the year 2000 came from private wells. Regional public systems and community systems provided the rest. The water-management district estimated a total withdrawal of approximately 19 Mgd in 2000 (SWFWMD 2008). The district's 2006 water-management plan forecasted the demands listed in Table 2-32, applying per capita usage rates ranging from 108–234 gpd based on 2001 usage by different users.

Table 2-32. Citrus County Forecast of Water Use

Year	2000	2005	2010	2015	2020	2025
Population[(a)]	128,331	135,774	150,888	164,913	177,709	188,969
Water Demand (Mgd)	19.132	20.226	22.495	24.586	26.494	28.173

Source: SWFWMD 2006

(a) The review team noted that the population estimates are higher than those provided in Table 2-16, although both tables were based on BEBR projections; SWFMD estimated a higher population for year 2000 (128,331) than was subsequently enumerated in the 2000 U.S. Census.

Wastewater Treatment

The review team obtained information about wastewater treatment in Levy County from the county comprehensive plan (Levy County 2008a, c). Over 75 percent of Levy County residents use septic systems for wastewater. Chiefland, Fanning Springs, the Yankeetown school, and a development in Yankeetown have each applied for a permit to construct a wastewater-treatment facility, with applications under review with FDEP in September 2009 (FDEP 2009j).

Levy County requirements for septic tank installation are consistent with or more stringent than State law. The county requires a minimum 1-ac lot for subdivisions served by private water systems and half-acre lots for subdivisions served by a community water system. The supporting data and analysis for the comprehensive plan estimated that approximately 18 percent of septic capacity to treat wastewater was being used by the population of unincorporated Levy County in 1990, assuming 75 gpd of wastewater generated per capita. Assuming that 60 percent of the county population will reside in unincorporated areas and using the 75-gpd wastewater-generation rate, the analysis provides estimated and projected figures for wastewater generation in unincorporated areas as shown in Table 2-33. The county does not have plans for a county sewage-treatment system, based on the assumption that most development will continue to be sparse in unincorporated areas and that local municipalities will

Table 2-33. Estimated Future Raw Sewage Output in Levy County

Year	1990	1995	2000	2010	2020
Levy County Population	25,000	27,200	29,000	32,200	35,700
Sewage generated in unincorporated Levy County (Mgd)	1.125	1.224	1.305	1.449	1.606

Source: Levy County 2008c.
(a) The review team noted that the population estimates are lower than those provided in Table 2-16; they were made before the 2000 U.S. Census.

extend sewer services out to industrial, commercial, and residential uses associated with municipal growth.

The review team obtained information about wastewater treatment in Citrus County from the county comprehensive plan (Citrus County 2008). Citrus County has five regional wastewater facilities owned by the county and a sixth owned and operated by a private utility company, Rolling Oaks. In addition, the cities of Crystal River and Inverness operate regional facilities. With the exception of the Rolling Oaks facility, for which there are plans for upgrades and eventual replacement the other facilities are expected to be operational for 25 to 30 years. Based on a 2000 wastewater facilities plan, Citrus County estimated the 2000 flow of wastewater in the system of regional facilities to be 0.353 Mgd. Citrus County projects future needs based on its level of service standard of 75 gpd per capita average (125 gpd peak) and 0.16 gpd per building square foot (0.30 gpd peak). To meet its goal of expanding the wastewater-treatment system to serve new developments within designated service areas, the county forecasted 2020 wastewater flows to be about 2.76 Mgd. The review team noted that appears to be sufficient capacity available either existing or planned to meet the 2020 forecast.

The review team obtained information about Marion County wastewater treatment from the sanitary sewer subelement of the Marion County Comprehensive Plan (Marion County 2008) from the Marion County Utilities Department (Marion County 2009), from the City of Dunnellon Comprehensive Plan (Dunnellon 2009), and from the Ocala/Marion County Economic Development Corporation (Ocala EDC 2009). Marion County projects future needs for wastewater facilities based on its LOS standard of 110 gallons per person per day, with commercial and industrial demand at 2000 gallons per acre per day. Marion County Utilities currently (figures reported on web pages in 2009) operates 11 wastewater-treatment facilities with a combined capacity of 4.25 Mgd and annual use of 2.164 Mgd; many of the plants are expandable. The city of Ocala operates three plants, with a combined capacity of 12.96 Mgd and annual use of 5.7 Mgd, and existing plants can be expanded to add an additional 5.5 Mgd for a total of about 18 Mgd. The city of Dunnellon wastewater-treatment plant has a capacity of 0.250 Mgd and current average daily flow of 0.115 Mgd. Considering projected population increases shown through 2025 in Table 2-16, which involve less than a doubling of the Marion County population, the review team interpreted these data to indicate that existing treatment facilities would have capacity to serve the added population.

Police Services

Law enforcement within the EIA is provided by 883 full-time law enforcement officers and 10 part-time officers employed by the Levy, Citrus, and Marion Counties sheriff's offices and police departments of Inglis, Williston, Chiefland, and Cedar Key in Levy County; Crystal River in Citrus County; and Dunnellon, Belleview, and Ocala in Marion County. The closest police stations to the LNP site are in Inglis and Dunnellon. Inglis and Dunnellon are approximately 4.1 mi and 18 mi from the site by road, respectively (Kimley-Horn 2009).

Inglis and Williston police departments work with the Levy County Sheriff's Office in providing law enforcement. Yankeetown, for example, does not have its own police force, and instead relies on the county, which is assisted by the Inglis and Williston police officers. Citrus County provides emergency evacuations and police functions in a number of smaller communities. Crystal River has one deputy assigned full time to the CREC and is otherwise served by the Citrus County Sheriff's Office. The Dunnellon Police Department indicated that it is at capacity for the provision of police support to its municipality with 15 sworn officers, including the chief (NRC 2009b; CH2M Hill 2009a) based on interviews with sheriff and police department staff.

Fire Department Services

Fire-fighting services within the EIA are provided by 6 county and 8 municipal fire stations in Levy County with 8 paid firefighters and 183 volunteer firefighters; 1 municipal and 23 county fire stations in Citrus County with 29 paid firefighters and 98 volunteer firefighters; and 27 fire stations in Marion County with 351 paid firefighters and 100 volunteer firefighters. The Inglis Fire Department (volunteer) and Dunnellon Fire Department (staffed) are closest to the LNP site. Inglis and Dunnellon are approximately 4.1 mi and 18 mi by road from the site, respectively. Local fire-protection services in Levy County are currently insufficient according to county officials. Future expansion and facility upgrades may be needed to accommodate future population growth (NRC 2009b; PEF 2009a), based on interviews with county and fire department staff (PEF 2009d; Kimley-Horn 2009).

Emergency Management

Levy County Emergency Management uses the 14 fire stations within the county, police support provided by the Levy County Sheriff's Office, the Nature Coast Regional Hospital for immediate care needs, and Shands Teaching Hospital and Clinic and Shands Alachua General Hospital for major medical issues. Marion County Emergency Management uses the county fire, rescue, and sheriff's departments as well as fire, rescue, and police resources from Dunnellon and Ocala; and West Marion Community Hospital, Ocala Regional Medical Center, and Munroe Regional Hospital for medical support. Citrus County Emergency Management Agency uses the Crystal River fire and police departments, Derosa Fire Station, Seven Rivers Regional

Medical Center, and Citrus Memorial Medical Center (PEF 2009a, based on interviews with county EMS staff; PEF 2009d).

Healthcare Services

Hospitals in the region are listed in Table 2-34 and their locations are shown in Figure 2-25.

There is one hospital in Levy County – Nature Coast Regional Hospital – about 24 mi from the LNP site. Patients from Levy County also use two hospitals in Alachua County, both about 45 mi from the LNP site: Shands Teaching Hospital and Clinic and Shands Alachua General Hospital. There are three physicians and 40 beds (on average 15 occupied) at Nature Coast Hospital for immediate emergency care. The Shands Teaching Hospital and Clinic has 634 beds (603-bed average occupancy), and Shands Alachua General Hospital has 262 beds (200-bed average occupancy). The two Shands hospitals within the three-county local area average 850 physicians to provide medical support. Hospital expansion and development plans include a cancer center at the Shands Teaching Hospital and Clinic (open as of 2010) and a proposed 60-bed hospital in Chiefland (at the fundraising stage in 2009).

Within Marion County, three hospitals are located between 26 mi and 30 mi from the LNP site. West Marion Community Hospital with 70 beds (63-bed average occupancy) and Ocala Regional Medical Center with 200 beds (180-bed average occupancy) are part of the Marion Community Hospital system, which employs 390 physicians. Monroe Regional Hospital has 421 beds (380-bed average occupancy) and 450 physicians. The Marion Community Hospital system has no immediate expansion plans and Monroe Regional Hospital has plans to add an additional 50 to 60 beds within the next 5 years.

Citrus County is served by two medical facilities. Seven Rivers Regional Medical Center, the closest to the LNP site at 13.5 mi, has 85 physicians and 128 beds (124-bed average occupancy). Citrus Memorial Medical Center, 24 mi from the LNP site, has 247 physicians and 198 beds (all occupied). Citrus Memorial Medical Center has plans to expand the emergency room and add additional beds, but no specific timeline for the expansion. The Seven Rivers plan in 2008 called for an addition of 16 beds, but instead they converted 16 existing beds for use for in-patient rehabilitation.

Overall, as indicated in Table 2-34, 7 of the 14 hospitals in the region plan for expansions within the next 5 years.

In discussions with public service providers, PEF obtained information about the adequacy of the capacity represented by the data provided above. PEF determined local fire, police, and emergency response services are adequate in Marion and Citrus Counties, but police services in Dunnellon (Marion County) are at capacity. PEF also concluded police and emergency response capabilities are adequate in Levy County, but fire-protection services are inadequate

Table 2-34. Medical Facilities Within the Region

Hospital Name (number corresponds with Figure 2-25)	Phone Number	Physicians	Beds	Occupancy of Beds	Expansion
Levy County					
1) Nature Coast Regional Hospital	352-528-2801	3	40	15	No current plans to expand.
Citrus County					
2) Seven Rivers Regional Medical Center	352-795-6560	85	128	124	Add an additional 16 beds within 1 year.
3) Citrus Memorial Hospital	352-726-1551	237	198	198	Plans to expand the emergency room.
Marion County					
4) Munroe Regional Medical Center	352-351-7200	450	421	380	Add 50 to 60 beds within the next 5 years.
5) West Marion Community Hospital	352-291-3000	390[a]	70	63	No current plans to expand.
6) Ocala Regional Medical Center	352-291-3000	390[a]	200	180	No current plans to expand.
Lake County					
7) Leesburg Regional Hospital	352-323-5568	296	309	226	No current plans to expand.
8) The Villages Regional Medical Center	352-323-5568	244	198	119	Currently expanding with an additional 60 beds.
Alachua County					
9) North Florida Regional Medical Center	352-333-4970	400	325	236	New cancer center
10) Malcolm Randall VA Medical Center	352-373-8040	430	285	285	Plan to expand with more beds within 5 years.
11) Shands Teaching Hospital and Clinic	919-265-0373	850[b]	634	600	New cancer center
12) Shands Alachua General Hospital	352-372-4321	850[b]	262	200	No current plans to expand.
Hernando County					
13) Spring Hill Regional Hospital	352-688-8200	389[c]	124	77	No current plans to expand.
14) Brooksville Regional Hospital	352-796-5111	389[c]	120	80	No current plans to expand.
15) Oak Hill Hospital	352-596-6632	300	204	NA	Expansion in 2 to 3 years.
16) Regional Medical Center Bayonet Point	727-819-2929	340	300	240	No current plans to expand.

Source: PEF 2009a, with data from interviews with hospitals and county health and EMS departments, as documented in PEF 2009d.
(a) Total includes both West Marion Community Hospital and Ocala Regional Medical Center.
(b) Total includes both Shands Teaching Hospital and Clinic and Shands Alachua General Hospital.
(c) Total includes both Spring Hill Regional Hospital and Brooksville Regional Hospital.
(d) Average occupancy percentage excludes Oak Hill Hospital because information was unavailable.
NA = Not applicable.

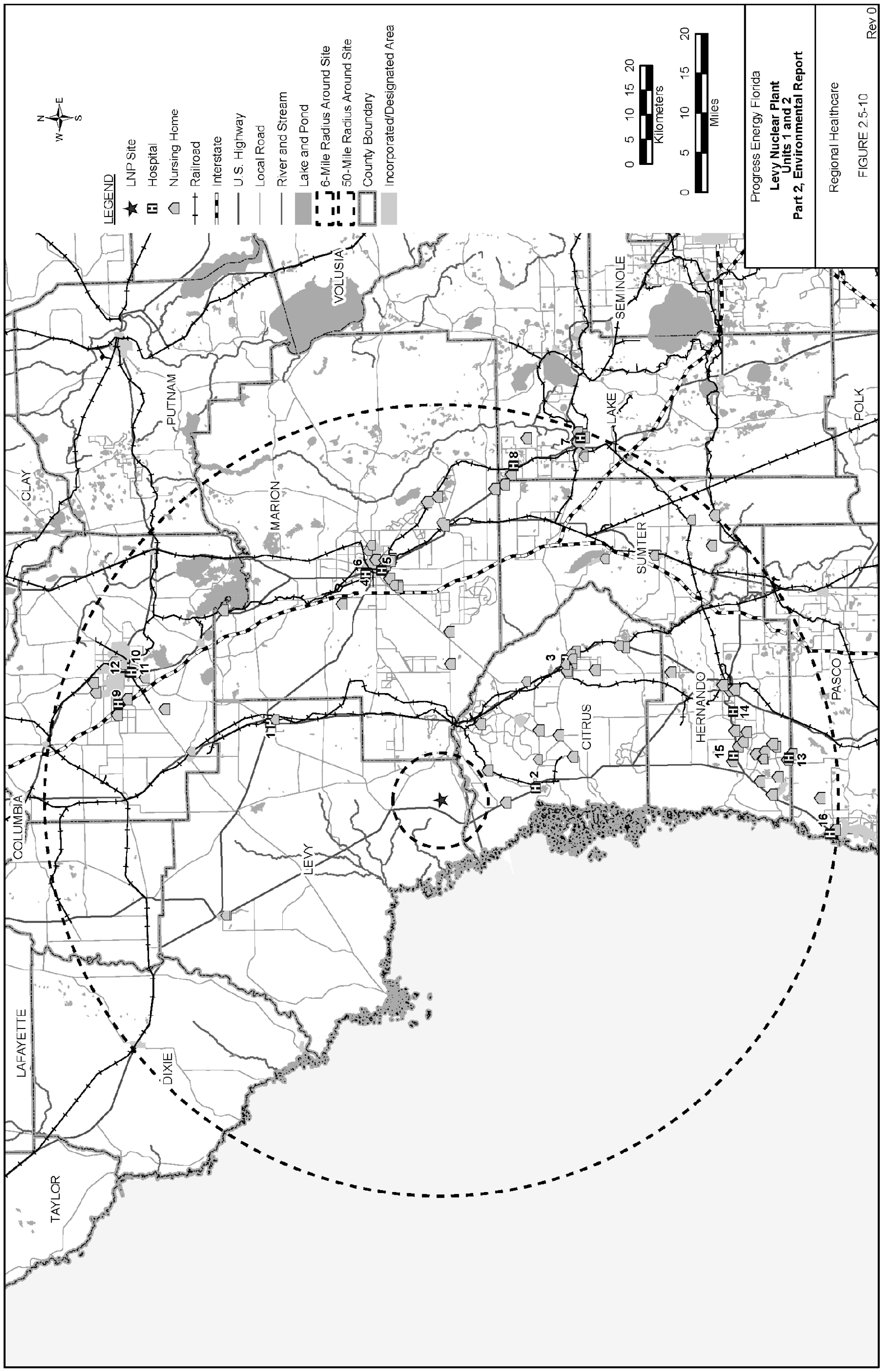


Figure 2-25. Regional Healthcare Services (PEF 2009a)

for current needs. PEF found medical capacity to be adequate in all three counties. Across the region, the existing hospitals have about 86 percent occupancy rate.

2.5.2.7 Education

The EIA includes 73 primary and secondary schools with a total enrollment for school year 2007–2008 of approximately 65,938 students. “Capacity” is measured in relationship to the availability of fixed classrooms and student stations within classrooms. To meet the concurrency requirement in State law, counties set LOS capacity targets, generally 100 percent or more, that require a developer to pay a proportionate fair share for the quantity of students attributable to its project (NRC 2009b). All EIA school districts use mobile classrooms to accommodate additional students when specific schools reach capacity. According to school district officials, Levy County schools were close to capacity in 2008, including the kindergarten through 8th grade (K-8) school at Yankeetown, the school closest to the LNP site; Levy high school students are bused to Dunnellon or Crystal River (NRC 2009b). Citrus County had three schools over capacity in 2008–2009, 14 under capacity, and projects 3 schools over capacity in school year 2011–2012 (Citrus County School District 2008). Marion County had 18 primary and secondary schools over capacity in 2008–2009 and projects 14 schools over capacity when the current 5-year workplan has been implemented in 2012–2013 (Marion County Schools 2009). Marion County’s Dunnellon High School and elementary school are crowded; both were over capacity in 2008–2009 and are expected to remain over capacity through the 5-year planning period. Dunnellon Middle school has available capacity; and there is available capacity in schools further north in the county (NRC 2009b).

In planning for future needs, school districts estimate the number of students per dwelling unit. Table 2-35 provides the estimates used by EIA school districts for households (Levy and Citrus Counties) and single-family dwellings (Marion County).

Table 2-35. Estimated Public School Students per Household

	Elementary School Students	Middle School Students	High School Students	Total Students
Levy County	0.2016	0.105	0.1134	0.42
Marion County	0.158	0.078	0.092	0.328
Citrus County	0.115	0.060	0.069	0.249

Sources: Henderson, Young & Company 2006; Citrus County et al. 2008; Levy County School District 2009.

The State Constitution Amendment of Section 1, Article IX (State of Florida 2002) mandates smaller student-to-teacher ratios from pre-kindergarten through 12th grade to be implemented by the beginning of the 2010–2011 school year. Schools can use mobile classrooms to comply with the student-teacher ratio requirements. Information for the 2007-2008 school year shows Levy County in compliance with the required 2007-2008 ratios at all schools; Citrus County out of compliance at two elementary schools, one middle school, and one high school; and Marion County out of compliance at two elementary schools and two middle schools (FDOE 2009b).

There are four community college organizations and two 4-year colleges and universities located within the region, but none is located within 10 mi of the LNP site. These schools include Central Florida Community College (Citrus, Hampton, Levy, and Ocala campuses), Lake-Sumter Community College (Sumter campus), Pasco-Hernando Community College (North and Spring Hill campuses), Santa Fe Community College (Northwest, Blount, Davis, and Kilpatrick campuses), University of Florida (main campus at Gainesville), and Beacon College (main campus at Leesburg) (PEF 2009a).

2.6 Environmental Justice

Environmental justice refers to a Federal policy established by Executive Order 12898 (59 FR 7629) under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.[a] The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040).

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the 50-mile region surrounding the site. The characterization in this section forms the analytical baseline from which potential environmental justice effects would be determined.

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and, in this discussion, the sum of the racial minority populations is referred to as the aggregate racial minority population. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race. The review team did not include Hispanics in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts (USCB 2001).

The review team reviewed the ER prepared by PEF and verified the data sources used in its preparation by examining cited references and by independently confirming data in discussions

(a) Minority categories are defined as American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity; "other" may be considered a separate minority category. Low income refers to individuals living in households meeting the official poverty measure. To see the U.S. Census definition and values for 2000, visit the U.S. Census website at http://ask.census.gov/.

with community members and public officials (NRC 2009b). The review team requested clarifications and additional information from PEF where needed to verify data in the ER. Unless otherwise specified in the sections below, the review team has drawn upon verified data from PEF (2009c, d, h). Where the review team used different analytical methods or additional information for its own analysis, the sections below include explanatory discussions and citations for additional sources.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the LNP site, using a GIS and the 2000 U.S. Census to identify minority and low-income populations. The review team then verified its analysis by conducting field inquiries of numerous agencies and groups (see Appendix B for the list of organizations contacted).

The first step in the review team's environmental justice methodology is to examine each census block group that is fully or partially included within the 50-mi region to determine for each minority or low-income population whether it should be considered a population of interest. If either of the two criteria discussed below identifies a census block group, that census block group is considered a population of interest. The two criteria are whether

- the demographic group exceeds 50 percent of the total population for the census block group, or
- the demographic group is 20 percentage points (or more) greater than the same population's percentage in the census block group's state.

The identification of census block groups that meet the above criteria is not sufficient for the review team to conclude that a disproportionately high and adverse impact exists. Likewise, the lack of census block groups meeting the above criterion cannot be construed as evidence of no disproportionate and adverse impacts. The review team also conducts an active public outreach and on-site investigation in the region of the proposed project to determine whether minority and low income populations may exist that were not identified in the census mapping analysis. To reach an environmental justice conclusion, starting with the identification of populations of interest, the review team must investigate all populations in greater detail to reveal key pathways that may have disproportionately high and adverse impacts on any unique characteristics or practices associated with a minority or low-income population. To determine whether disproportionately high and adverse effects may be present, the review team considers the following:

Health Considerations

1. Are the radiological or other health effects significant or above generally accepted norms?
2. Is the risk or rate of hazard significant and appreciably in excess of the general population?
3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?

Environmental Considerations

4. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
5. Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those on the general population?
6. Do the environment effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard? (NRC 2007c)

If this investigation in greater detail does not yield any pathways that could lead to potentially high and adverse impacts on populations of interest, the review team may conclude that there are no disproportionately high and adverse affects. If, however, the review team finds any potentially disproportionate and adverse effects, the review team would fully characterize the nature and extent of the impact and consider possible mitigation measures that may be used to lessen it. The remainder of this section discusses the results of the search for potentially affected populations of interest.

2.6.2 Analysis

Drawing on data presented in Section 2.5.1, this section presents the USCB 2000 demographics of the minority and low-income populations that reside within a 50-mi radius of proposed LNP Units 1 and 2 (the region), including the three-county local area (Levy, Citrus, and Marion Counties). The consideration of a 50-mi comparative geographic area surrounding the LNP site, which includes all or portions of 11 counties, is based on the guidance provided by NUREG-1555 (NRC 2000). Figure 2-26 shows the counties within the region and their geographic relationship to the site. Levy and Citrus Counties are entirely within the region and more than three-quarters of Marion County falls within the region.

2.6.2.1 Location of Minority and Low-Income Populations

The analysis of the locations of minority and low-income populations within a 50-mi radius of proposed LNP Units 1 and 2 was performed using the Environmental Systems Research Institute ArcMap® GIS software and USCB's Summary File 1 data and Topologically Integrated

Geographic Encoding and Referencing (TIGER) census block group boundaries from 2000.[(a)] The entire census block group was included in the analysis if any part of the block group was inside the 50-mi radius. The ArcMap® GIS software and 2000 census data were then used to determine the minority and low-income characteristics by census block group within 50 mi of the LNP site.

There are 536 census block groups wholly or partially within a 50-mi radius of the centerpoint at latitude 29.073598 and longitude -82.62078, the midpoint between proposed LNP Units 1 and 2 (PEF 2009a, based on the methods described above).

2.6.2.2 Minority Populations

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and, in this discussion, the sum of the racial minority populations is referred to as the aggregate racial minority population. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race including any one of the identified racial populations. The review team did not include Hispanics in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts (USCB 2001).

USCB 2000 data present the Florida population as containing the following:

- 0.3 percent American Indian or Alaskan Native
- 1.7 percent Asian
- 0.05 percent Native Hawaiian or other Pacific Islander
- 14.6 percent Black or African American
- 3.0 percent other single race
- 2.4 percent multi-racial
- 22.1 percent aggregate of minority races
- 16.8 percent Hispanic ethnicity.

This provides the following threshold values for the second (20-percent) criterion:

- 20.3 percent American Indian or Alaskan Native
- 21.7 percent Asian
- 20.05 percent Native Hawaiian or other Pacific Islander
- 34.6 percent Black or African American
- 23.0 percent other single race
- 22.4 percent multi-racial

(a) A census block is the smallest geographic area for which the USCB collects and tabulates decennial census data. A block group is the next level above census blocks in the geographic hierarchy and is a subdivision of a census tract or block numbering area.

- 42.1 percent aggregate of minority races
- 36.8 percent Hispanic ethnicity.

Figure 2-26 shows the census block groups in which the aggregate minority population meets at least one of the two significance criteria. Fifty-six census block groups within the 50-mi radius have aggregate minority populations that are 20 percent greater than the aggregate minority's average in Florida. Of the 56 block groups, 44 have aggregate minority populations of 50 percent or more. The closest minority census block group of interest is in Citrus County, about 10 mi southeast of the LNP site.

Figure 2-27 shows the census block groups in which the African-American population meets at least one of the two criteria. Sixty blocks within the 50-mi radius have African-American populations that are 20 percent greater than the Florida average; of these, 41 have African-American populations of 50 percent or more. As the figure shows, the closest block group with a significant African-American population is the same census block group identified above, slightly south and east of the LNP site in Citrus County between Dunnellon and Citrus Springs. There are significant concentrations of African-American populations around the urban centers of Gainesville and Ocala, as well as in more rural areas in Levy, Marion, and Sumter Counties.

Figure 2-28 shows the single census block group within the 50-mi radius in which the Hispanic ethnicity population meets at least one of the two criteria. This block group, in the far southeastern sector of the region near the Pasco and Hernando County lines, has a Hispanic ethnicity population that is more than 20 percent above the Florida average and also greater than 50 percent of the population of the block group.

There are no census block groups in which the populations of any other racial or ethnic group meet either of the two criteria. The review team determined through analysis of PEF's ER and other data sources that neither Native American reservations nor any housing reserved for Native Americans exist within the EIA.

2.6.2.3 Low-Income Populations

The Florida State average for individuals below poverty is 12.5 percent, based on 2000 U.S. Census data for 1999 incomes. This provides 32.5 percent as the threshold value for the second (20 percent) criterion.

Figure 2-29 shows the distribution of census block groups containing low-income populations of significance within the 50-mi radius. Forty-four census block groups have significant low-

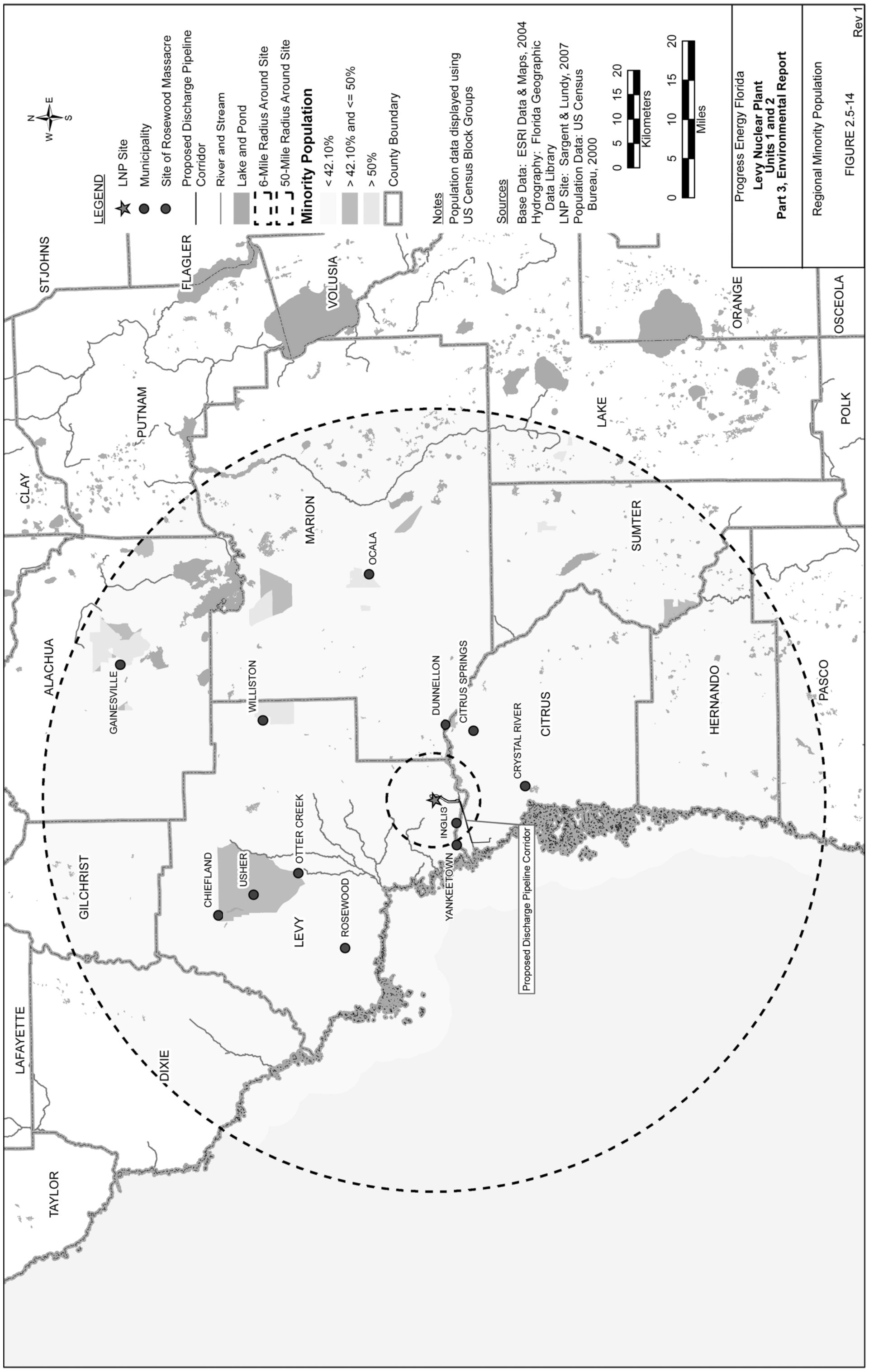


Figure 2-26. Regional Minority Population (PEF 2009a)

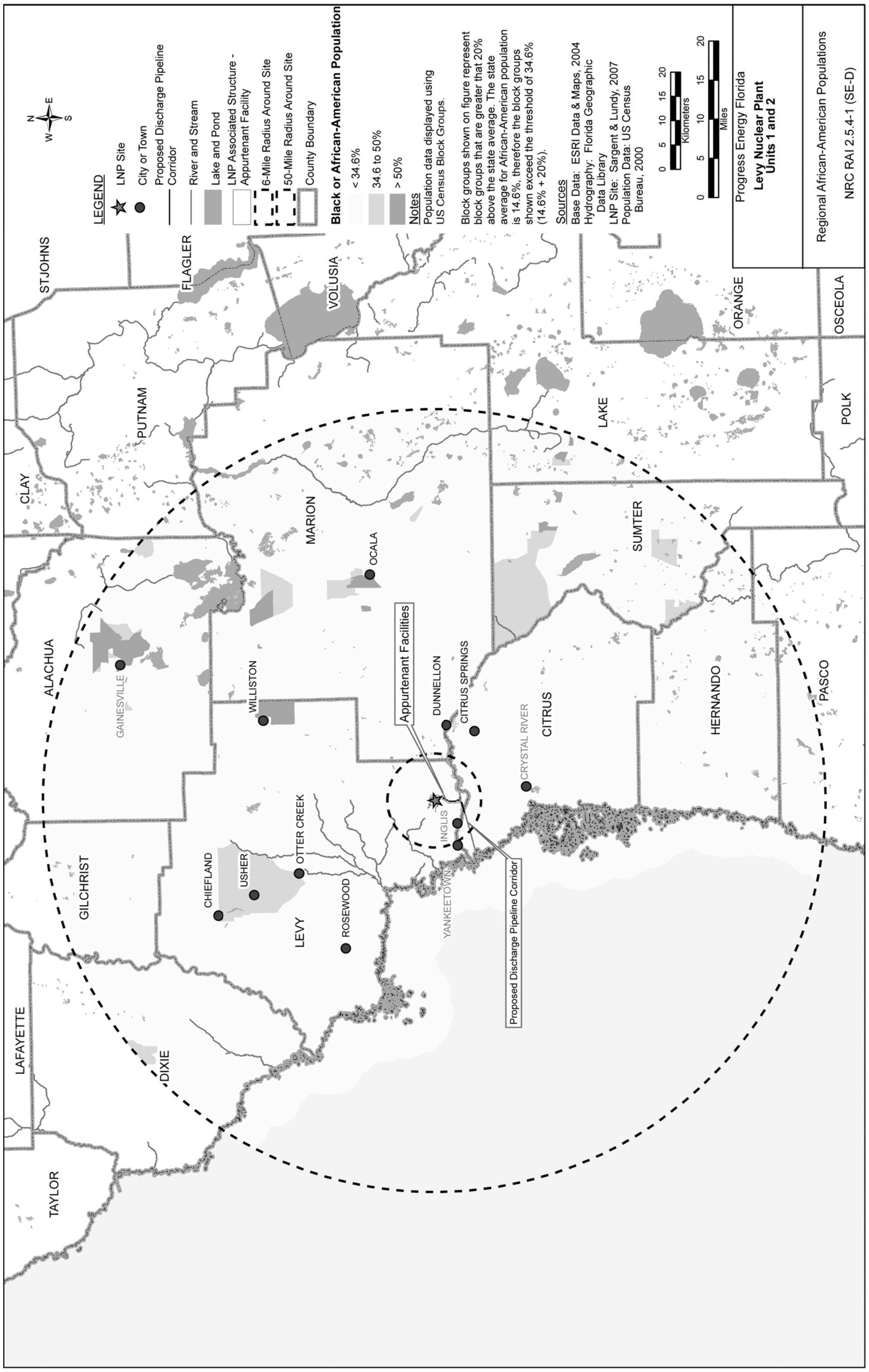


Figure 2-27. Regional African-American Population (PEF 2009h)

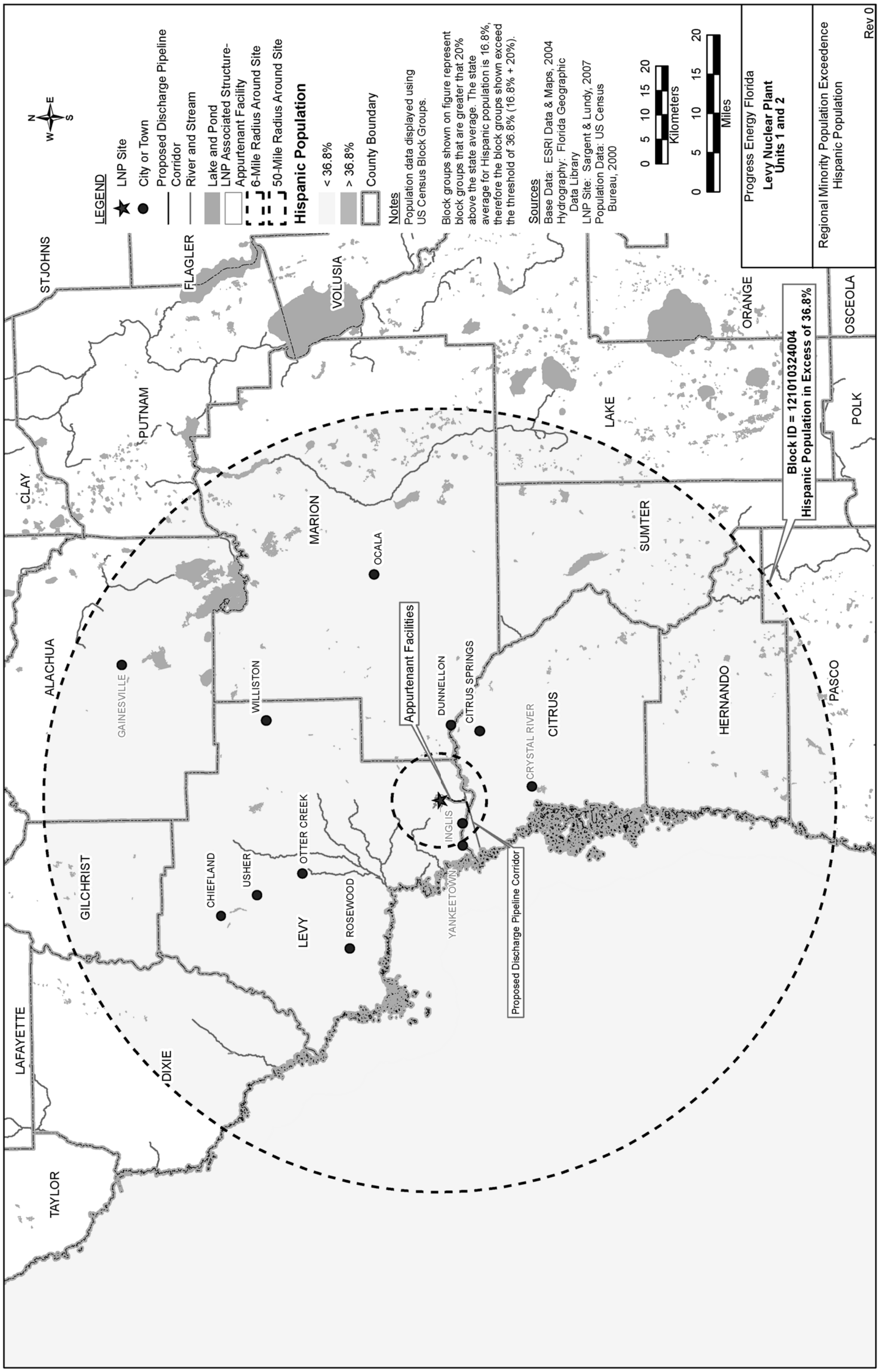


Figure 2-28. Regional Hispanic Population (PEF 2009h)

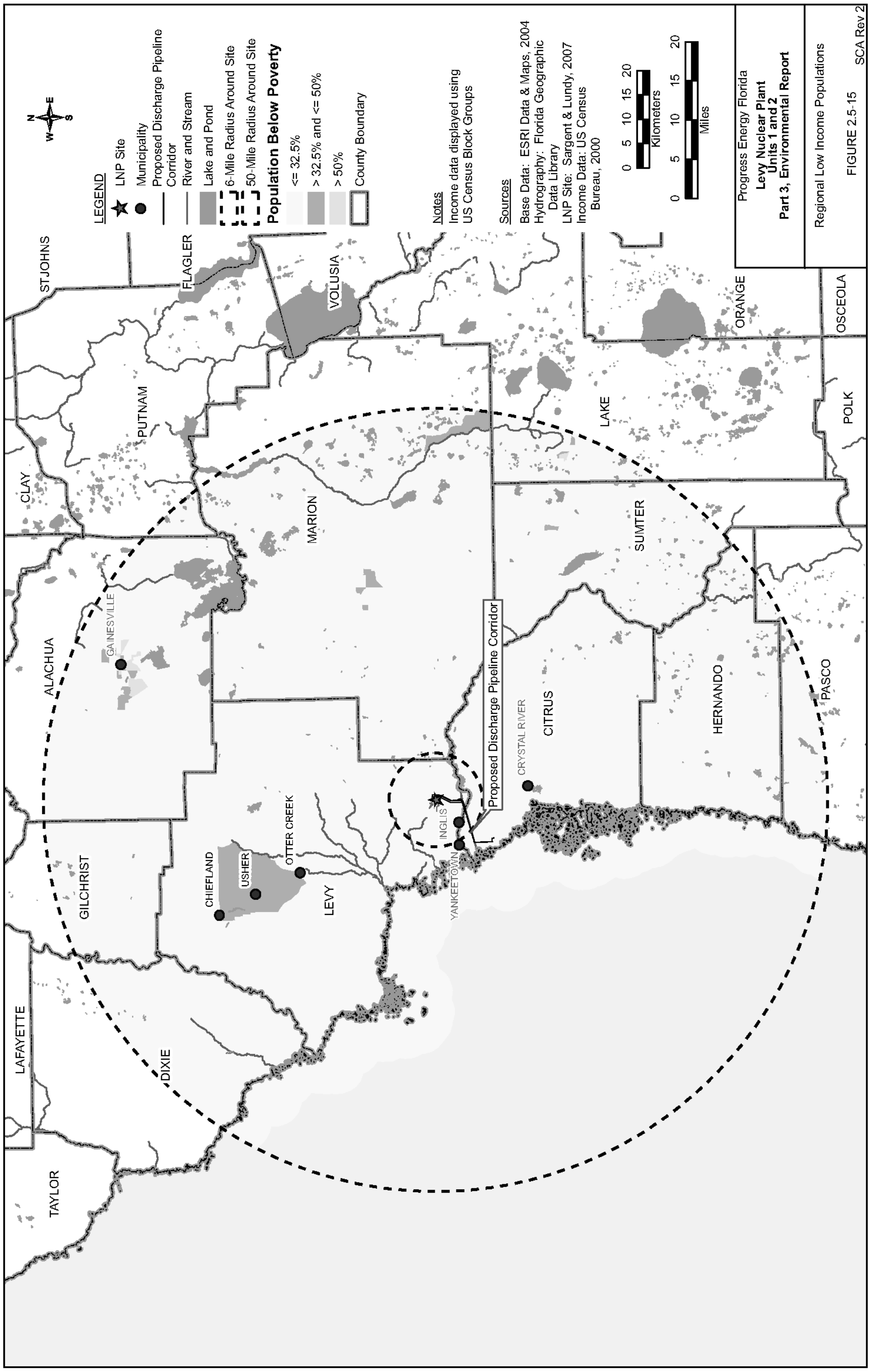


Figure 2-29. Regional Low-Income Population (PEF 2009a)

income populations; of these, 14 have 50 percent or more low-income individuals. The closest concentrations are around Otter Creek-Usher-Chiefland in Levy County, about 20 mi north of the site; and Ocala in Marion County, more than 30 mi from the site. The areas with 50 percent or more low-income individuals are primarily around Gainesville (Alachua County), with one block group in Lake County.

2.6.2.4 Communities with Unique Characteristics

NRC's environmental justice methodology includes an assessment of high-density communities and populations with unique characteristics. High-density communities are minority or low-income "pockets" of populations that are not discerned by the census but that might suffer a disproportionately high and adverse impact from construction, preconstruction, or operation of a project. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, proximity to a source of impacts, or exceptional dependence on subsistence resources, but such unique characteristics need to be demonstrably present in the population and relevant to the potential environmental impacts of the plant. If the impacts from the proposed action appear to affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then a determination is made whether the impact is disproportionate when compared to the general population.

High-Density Communities

The review team met with community members and public officials and made field observations to investigate whether there were such high-density communities within the vicinity of the LNP site. The investigations indicated that there is little settlement near the proposed plant site; and the income and racial characteristics of those near the site are not different from those away from it. Based on this information, the review team concluded that there are no minority or low-income pockets that were not captured by the census block group analysis.

Subsistence

Common subsistence behaviors include gardening, gathering plants, fishing, and hunting. Natural resources may be used to supplement store-bought foodstuffs or medications for budgetary purposes, or for ceremonial and traditional cultural purposes. Subsistence information is often site-specific and it can be difficult to differentiate between the subsistence and recreational uses of natural resources. In this section, the review team presents subsistence information in a qualitative manner, based on anecdotal information.
Information about subsistence populations came from interviews with local officials and staff of economic impact area county health departments, school districts, and the Goethe State Forest, situated adjacent to the LNP site (NRC 2009b, PEF 2009a). None of these entities tracks subsistence users quantitatively, nor did any have information specific to the site. The Levy

County Health Department is aware that some county households rely on subsistence hunting or fishing. A Levy School District official noted that because clamming is an industry in Cedar Key, perhaps there is some subsistence consumption as well. Staffs of the Citrus County Women-Infant-Children (WIC) Program and the Nutrition Program estimate that about 3000 women and children use the WIC program annually. Of these, perhaps 10 percent rely on subsistence fishing. While the local officials indicated that hunting of turkeys, wild hogs, and deer on timber lands (both in and out of the State forest) takes place, they were not able to supply the review team with an estimated level of subsistence use.

Through its review of PEF's ER, its own outreach and research, and scoping meeting comments, the review team identified no communities with unique characteristics other than subsistence that would make them susceptible to disproportionately high and adverse impacts.

2.6.3 Scoping and Outreach

The review team interviewed local and county officials, business leaders, and interested members of communities within the EIA and assessed the potential for disproportionately high and adverse environmental effects on minority and low-income communities (NRC 2009b). In general, the information was consistent with data mapped using USCB information. Interviewees from Citrus County School District indicated that Citrus County has the lowest minority population (including Hispanic ethnicity) in the EIA. This is consistent with the mapped data. One school district official from Levy County said that Williston has a greater percentage of African Americans, while Bronson and Chiefland have a greater percentage of Hispanic ethnicity; and noted that minority households tend to be “mid-lower income.” School district officials reported that 48 percent of the students in Citrus County qualify for free or reduced lunch programs; and only two schools in Levy County do not qualify for Federal aid for free or reduced-cost lunch programs. Eligibility for these programs is based on household income.

The review team issued an advanced notice of public hearings for EIS scoping purposes in accordance with NRC's guidance (NRC 2007a). The review team had some response in its outreach effort to minority and low-income populations, as evidenced by public comments from African-American community members at the December 4, 2008 public meeting in Crystal River. Through the interviews and scoping meetings, the review team did not learn of any additional significant populations of minority or low-income persons not already identified through the USCB mapping exercise and personal interviews.

2.6.4 Migrant Populations

The USCB defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from his or her permanent place of residence. The USDA 2002 Agricultural Census provides the following information about farms, workers, and use of migrant workers (USDA 2002). Levy County reported 322 farms and 1013 workers; 8 farms used migrant labor. For Citrus County, 55 farms and 245 workers were reported; 1 farm employed migrant labor. Marion County reported 771 farms, 3824 workers; 2 farms employed migrant labor. The review team was unable to identify a source that quantified the number of migrant workers by county, but reviewed the method used to allocate migrant workers in Table 2-20 and agrees with the estimates of 25, 5, and 10 migrant workers in Levy, Citrus, and Marion Counties, respectively.

The LNP site and environs are used for tree plantations, not for crops harvested in patterns that attract migrant workers.

One public official from Levy County noted that there are some transient farmworkers of Hispanic ethnicity, mostly in the Williston and Chiefland areas where peanuts and watermelon are grown (NRC 2009b). This is consistent with the USDA census data.

2.6.5 Environmental Justice Summary

The review team found low-income, African-American, Hispanic, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses. The review team performed additional analyses to identify any potential communities with unique characteristics or practices that could lead to an environmental justice impact from the proposed site. The review team found that dependence on subsistence activities was the only such unique characteristic. As a result of these findings, the review team had to perform further studies before making a final environmental justice determination. These analyses can be found in Chapter 4 for construction and preconstruction impacts and in Chapter 5 for operational impacts.

2.7 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the review team has elected to use the process set forth in the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321, et seq.), to comply with the obligations imposed under Section 106 of the National Historic Preservation Act (NHPA) (16 USC 470, et seq.). The review team determined that the direct effects Area of Potential Effect (APE) for the COL review is the area at the power plant site and the immediate environs that may be physically affected by land-disturbing activities associated with constructing and operating two new nuclear generating units. The indirect effects APE for the LNP site is the area that may be visually affected. The indirect effects APE is determined by the maximum distance from which the tallest structures associated with proposed Units 1 and 2 can be seen from offsite locations.

This section discusses the historic and cultural background in the region surrounding the LNP site. It also details the efforts that have been taken to identify cultural resources in the physical and visual APEs and the resources that were identified. A description of the consultation efforts is also provided. The assessments of effects from building and operating the proposed new units are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

This section provides an overview and summary of the cultural history of the LNP site and region. The discussion of precontact history is derived from cultural resources investigations completed for the LNP site (Smith et al. 2008; Orton 2008). The region around the LNP site has a rich cultural history and a record of significant prehistoric and historic resources with evidence of continuous settlement in the area for 10,000 years, particularly along the Florida Gulf Coast. Prehistoric occupation of the area is divided into three periods as summarized below:

- Paleoindian (13,000–10,000 Before Present [BP]) – This period of human occupation in the peninsular coast began at the end of the Pleistocene Epoch. This period is typically characterized by the presence of small mobile bands of people seasonally dependent upon large and small game, fish, shellfish, and plants. Archaeological sites from this period are easily identified by the presence of stone tools or projectile points (i.e., Clovis, Suwannee, Simpson, Tallahassee, Beaver Lake, and Santa Fe), as well as expedient tools and tools formed from the bones of Pleistocene fauna.

- Archaic (9500–2500 BP) – The Archaic period is divided into Early (9500–7000 BP), Middle (7000–5000 BP), and Late, (5000–2500 BP) phases divided into Orange (4000 BP) and Transitional (3200-2500 BP) subphases. These phases are defined on the basis of increasingly sedentary settlement patterns and changing diagnostic projectile point typologies. During the Early phase, there is evidence of at least seasonal camp sites, often expressed by the presence of large middens (i.e, refuse piles of archaeological material). The Middle phase is marked by a noticeable change in lithic technology. The change in lithic technology is more noticeable from Early to Middle Archaic than it is from Paleoindian to Early Archaic likely representing change in the resources used. The Late phase is marked by the first occurrence of pottery at the onset of the Archaic Orange subphase (4000 BP). The presence of this pottery represents a sedentary lifestyle with a need for food and material storage. This pottery was molded and fiber-tempered with vegetable fibers. The Archaic Transitional subphase is marked by the appearance of regional ceramics and evidence of increasingly larger village sites and associated middens.

- Post-Archaic/Regional Cultures (2500–200 BP) – During this period, people appear to have become more sedentary and particularly adept at exploiting resources found within their environment, resulting in an overall increase in population growth. There is increased pottery production, showing regional or cultural affiliation. Post-Archaic cultures are distinguished by the use of burial mounds and cultivated plants to supplement wild foods. There is evidence of a decrease in stone tools and an increase in utilitarian tools, such as containers and ornaments fashioned from bone or shell.

The history of the Gulf Coast of Florida from its discovery in 1528 to the end of the third Seminole War in 1858 is summarized from the following references:

- Crystal River Energy Complex Environmental Review application for license renewal (PEF 2008c).
- Levy Units 1 and 2 Environmental Report (PEF 2009a)
- Phase I Cultural Resource Assessment Survey for the Levy County Nuclear Power Plant (LNP) 2008 (Smith et al. 2008)
- Cultural Resource Investigation for the LNP Site and Associated Facilities (Levy and Citrus Counties, Florida) 2008 (Orton 2008)

Between 1528 and 1559, three Spanish explorers – Panfilo de Narvaez, Hernando de Soto and Tristán de Luna y Arellano – arrived in the Gulf Coast of Florida region to search for gold and colonize the area. Although their attempts were unsuccessful, the explorers did encounter Timucuan-speaking tribes that lived in the region. Over the next two centuries, the Spanish, French, and the English attempted to build settlements on the peninsula. The Spanish controlled Florida until 1821 when it was ceded to the United States.

Changes in Native American occupation resulted in the Timucuan-speaking tribes being absorbed by the Seminoles. Conflict between settlers and the Seminoles was defined by warfare and slave raids until the mid-19th century. Both this conflict and disease contributed to the near-extinction of the Seminoles by the mid-19th century. By 1858 at the end of the third Seminole War, only 200 Seminoles remained.

Although historical documentation suggests there may have been fighting on the LNP site, there is no archaeological or other physical evidence to support this suggestion (Smith et al. 2008). Nine forts were reportedly established in Levy County as part of the conflict with Native Americans in the region with the Second and Third Seminole Wars (Smith et al. 2008). Economic development in the surrounding areas contributed to an increase in agriculture and hence population, with a tripling of people, one fourth of them slaves, over a period of 10 years (1850–1860). This increase was also due to the county's foremost port and manufacturing center, Cedar Key, and to the cross-state railroad that was promoted by David Levy Yulee for whom Levy County is named. Cedar Key was occupied by both northern and southern troops during the Civil War, but no battles were recorded in the project area. Following the war, Cedar Key was repaired and the lumber industry that drove it rebounded and grew. This growth during the late 1800s spread into Levy County in the form of logging (late 1800s) and turpentine production (early 1900s) that changed the economic focus from agriculture to forest plantation.

The town nearest the project area was first recorded as Black Dirt in 1860. Over the next 30 years it changed its name from Black Dirt to Blind Horse, and from Blind Horse to Inglis, and became an important river port for the Withlacoochee River during the early 1900s. As part of this economic development, a short spur of railroad was built running from Dunnellon to Inglis. The declined use of the railroad may have occurred as early as 1932, as roads were made more travel-worthy for automobiles and as economic competition decreased business for Inglis. Around 1910, Levy County started to see its first decrease in population. This decrease from just over 10,000 people could have been partly due to depleted timber and sap resources and competition in forest plantation fostered by the invention and use of the Herty cup in Georgia for harvesting sap. The Herty cup quickly made its way to Florida, and fragments and pieces of them can still be seen in the project area. The mid- to late-1900s saw slow deforestation of the project area as aerial photos show decreasing forest coverage.

2.7.2 Historic and Cultural Resources at the Site and Offsite Areas

To identify the historic and cultural resources at the LNP site, the staff reviewed the following information:

- Levy County Nuclear Plant COL ER, Rev 1 (PEF 2009a)
- New South Technical Report – Phase I Cultural Resource Assessment Survey for the Levy County Nuclear Power Plant (LNP) 2008 (Smith et al. 2008)
- CH2M Hill Technical Report – Cultural Resource Investigation for the LNP Site and Associated Facilities, Levy and Citrus Counties, Florida, 2008 (Orton 2008)
- NRC Site Visit and Audit – NRC staff consulted with the Florida State Historic Preservation Office (SHPO) and also conducted an on-the-ground visit to the Levy site (NRC 2009a)

The reports by Smith et al. (2008) and Orton (2008) are available at the Florida SHPO for qualified investigators.

The following sections describe archaeological resources, above-ground resources, and traditional cultural properties (TCPs) that are located within the indirect and direct effects APE for the LNP site. The APEs and research methodology have been generally defined by PEF in consultation with the Florida SHPO (Florida SHPO 2007a, b; 2008b).

The direct effects APE, which includes physical impacts on known resources resulting from the construction and operation of the LNP, was defined in the ER (PEF 2009a) and Smith et al. report (2008) as follows:

- the 300-ac area slated for the construction of LNP Units 1 and 2, which is within the LNP site boundary
- an approximately 3300-ac area, which includes the 3105-ac LNP site boundary

- the 2500-ac area for the corridor that contains a transmission line corridor, and heavy-haul road, and portions of the blowdown line (referred to as Lybass corridor by Smith et al. (2008))
- the remaining portions of the blowdown pipeline not included in the 2500-ac area mentioned above.

The indirect effects APE, which takes into account viewshed impacts on above-ground resources and TCPs, has been defined by PEF in consultation with the SHPO as a 0.5-mi APE and a 1-mi radius APE around the cooling towers (PEF 2009a, c).

2.7.2.1 Archaeological Resources

Over the last 40 years, numerous archaeological investigations have been completed in the area around the proposed project direct effects APE, as described by Smith et al. (2008). Between 1966 and 2006, nine archaeological investigations were conducted adjacent to the LNP site, including three within or directly adjacent to the APE. This previous work around the APE has resulted in numerous archaeological sites being recorded. Files maintained by the Florida Division of Cultural Resources, a department of the Florida SHPO, document seven isolated finds or archaeological occurrences (AOs; involving two or fewer artifacts) and three archaeological sites within a 1-mi radius, but outside of the proposed 3300-ac plot and 2500-ac tract APEs. None of these discoveries has been determined to be eligible for listing in the National Register of Historic Places (NRHP or National Register) (PEF 2009a; Smith et al. 2008).

Forty-seven sites have been recorded within 1 mi of the southern blowdown APE terminus near the coastal portion of the project outside the APE. Five of the 47 have been recommended as being eligible for listing in the National Register by the investigators that identified them, without evaluation or concurrence from SHPO. None of the sites occur in the APE.

A Phase I archaeological investigation of the above-listed four APE areas was conducted for the Levy COLs (Smith et al. 2008). Prior to the investigation, only two archaeological isolated finds had been previously recorded within the current APE (8LV499 and 8LV485) and both had been determined to not be eligible for listing in the National Register (Smith et al. 2008; PEF 2009a). Investigators were unable to locate these isolates during the 2007 investigation.

The Phase I investigation resulted in the identification of four isolated finds and one archaeological site, a lithic scatter site (8LV744) within the 3300-ac LNP tract. The investigation for the 2500-ac tract yielded two isolated finds: one historic site (8LV746), a portion of the historic rail line spur from Dunnellon to Inglis ca 1905–1932, and one prehistoric site (8LV475), a lithic scatter. The six isolates (AOs 1–6) and the three sites (8LV744, 8LV745, and 8LV746) were not considered to be eligible for listing in the National Register. The isolates were considered not eligible because they “do not meet the criteria established by the Florida Division of Historical Resources, Bureau of Archaeological Research for recording as a site” (Smith et al. 2008). The two prehistoric sites, 8LV744 and 8LV745, were determined to not be eligible due to the sparse and nondiagnostic nature of the artifact scatters. The historic railroad grade was determined not eligible because “[t]he remains of the rail spur do not exhibit characteristics that would make this linear remnant eligible for listing in the NRHP” (Smith et al. 2008). Florida SHPO concurred with PEF’s findings that there are no historic properties present and no further work is recommended (Smith et al. 2008; Florida SHPO 2008b).

The CFBC was recommended by PEF as not being eligible for listing in the National Register (Orton 2008). This assessment was made based on the canal being less than 50 years old, and having “not achieved [the] exceptional importance” needed to be an exception to the 50-year minimum age necessary for eligibility for the National Register (Orton 2008). This assessment received Florida SHPO concurrence (Florida SHPO 2008a).

2.7.2.2 Above-Ground Resources

Background research for above-ground resources was completed by qualified staff (Orton 2008). This research included visits to local libraries and repositories, a search of the National Park Service Historic Property database online, phone conversations with SHPO, and a search of the Florida Master Site File database (Orton 2008; PEF 2009a). PEF also researched parcel data, historic plat maps, titles, and real-estate records. An above-ground resources survey of the direct effects and indirect effects APE revealed no structures built in 1957 or earlier, which would make them 50 years or older. This 50-year minimum age is necessary for eligibility of standing structures in the National Register.

2.7.2.3 Traditional Cultural Properties

No TCPs were identified in either the direct- or indirect-effects APE by the Phase I work (Orton 2008; Smith et al. 2008). The Florida SHPO concurred with PEF’s conclusion (Orton 2008; Smith et al. 2008; Florida SHPO 2008a). By letters dated February 14, 2008, the Miccosukee Tribe, the Muscogee Nation of Florida, the Perdido Bay Tribe of Lower Muscogee Creek, and the Seminole Tribe of Florida were contacted by PEF requesting information and input regarding the LNP Units 1 and 2 COL application (PEF 2009c). The Miccosukee Tribe and Seminole Tribe of Florida were contacted by the NRC regarding the proposed project to invite them to participate in the identification of historic and cultural properties (NRC 2008a, b). The Miccosukee Tribe responded to both the NRC (2008a) and PEF (PEF 2009c) stating they had no knowledge of cultural resources within the project area. In addition, the Perdido Bay Tribe of Lower Muscogee Creek was contacted by letter dated August 31, 2009 (NRC 2009c), and the Seminole Tribe of Oklahoma and the Muscogee Nation of Florida were contacted by NRC by letters dated May 27, 2010 (NRC 2010a, b). As of June 2010, no TCPs have been identified by the tribes contacted. Because no TCPs have been located or identified, none are likely to be affected.

2.7.2.4 Transmission Lines

A description of the transmission-line corridors is included in Section 2.2.2. A work plan for a Phase I investigation, a schedule for this Phase I work, and desktop cultural resources investigation have been completed for the proposed transmission lines (PEF 2009d). Results of the desktop survey for the transmission-line corridor from the proposed LNP to the proposed Citrus substation (LPC), the transmission-line corridor from the proposed LNP to the CREC 500-kV switchyard (LCR), and the transmission-line corridor from the proposed LNP to Central Florida South substation (LCFS) show that there are 29 cultural resource assessment surveys for these three proposed corridor alternatives (LPC, LCR, and LCFS (PEF 2009a).

The LCFS corridor contains one NRHP-eligible site (8SM128), and two sites having confirmed or potential human remains (8SM10 and 8SM84). Site 8SM128 is a site with both historic and prehistoric components. Site 8SM10 is an NRHP-unevaluated burial mound site. Site 8SM84 is a cemetery with documented use into the 1980s. According to PEF (2009a), "These sites will be avoided to the maximum extent practicable during [right-of-way] selection and structure placement as described in ER Section 9.4.3. If avoidance of these three resources is not feasible, then appropriate minimization or mitigation measures will be developed in coordination with the SHPO." PEF has agreed to complete comprehensive Phase I surveys prior to construction activities, once transmission-line rights-of-way within the corridors are finalized (PEF 2009a).

2.7.3 Consultation

In November 2008, NRC initiated consultation on the proposed action by writing to the Florida SHPO and the Advisory Council on Historic Preservation (ACHP). The NRC received a reply from the Florida SHPO on December 11, 2008 (Florida SHPO 2008c), which indicated that the office received the cultural resource assessment from PEF and that no historic or cultural resources had been identified to date. The NRC received correspondence from the ACHP on February 17, 2009, which summarized NRC's requirements under Section 106 of the NHPA and 36 CFR Part 800 (ACHP 2009).

By letters dated November 5, 2008 (NRC 2008a, b), the NRC initiated consultations with two Federally recognized tribes, The Miccosukee Tribe and the Seminole Tribe of Florida, regarding the proposed COL application. By letter dated August 31, 2009 (NRC 2009c), the NRC initiated consultation with one non-Federally recognized tribe, the Perdido Bay Tribe of Lower Muscogee Creeks, regarding the proposed COL application. By letter dated May 27, 2010 (NRC 2010a), the NRC initiated correspondence with a non-Federally recognized tribe, the Muscogee Nation of Florida, regarding the proposed COL application. By letter dated May, 27, 2010 (NRC

2010b), the NRC initiated consultation with the Federally recognized Seminole Tribe of Oklahoma regarding the proposed COL application. In the letters, NRC provided information about the proposed action, indicated that review under the NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited the opportunity to identify concerns, provide advice on the evaluation of historic properties, including those of traditional, religious, and cultural importance, and participate in any necessary resolution of adverse effects to such properties. The Miccosukee Tribe responded on December 10, 2008, stating it had no direct knowledge of cultural resources within the project area, but recommended that cultural resource surveys be conducted (Miccosukee Tribe 2008). The NRC responded by letter dated August 25, 2009 (NRC 2009d) providing information regarding cultural resources surveys conducted by PEF. The Seminole Nation of Oklahoma, in response to the NRC's correspondence, asked that the NRC work through the Seminole Nation of Florida for development of the EIS and to keep their tribe informed. As of June 2010, no other Tribes have responded to NRC.

On December 4, 2008, NRC conducted a public scoping meeting in Crystal River, Florida, at which no comments or concerns regarding historic and cultural resources were made.

2.8 Geology

A summary of the geology of the LNP site is provided in Section 2.6 of the ER (PEF 2009a). The geology and associated seismological and geotechnical conditions at the LNP site are described in greater detail in Section 2.5 of the FSAR, which is another part of the COL application (PEF 2009k). Both the ER and the FSAR incorporated information obtained from onsite subsurface investigations performed in support of the COL application. The NRC staff's description of the geological features and the technical analyses related to safety issues will be presented in the SER.

The LNP site, which is located in southern Levy County, Florida, lies within the "mid-peninsular physiographic zone of the Coastal Plain province of the Atlantic Plain division of North America. The mid-peninsular zone is characterized by discontinuous subparallel ridges lying parallel to the length of the peninsula" (Florida Geological Survey 1992). As shown in Figure 2-30, the LNP site lies within the Gulf Coastal Lowlands subdivision of the mid-peninsular zone.

The principal aquifer in the area near the proposed LNP is the Upper Floridan aquifer. The Upper Floridan is one of the aquifers within the Floridan aquifer system, which is a thick sequence of carbonate rock, primarily limestones and dolomites of Tertiary Age. Figure 2-31 shows the generalized hydrostratigraphy for the Floridan aquifer system in west-central Florida. Aquifers within the Floridan aquifer system are defined based on their permeability, with productive zones being classified as aquifers and low-permeability intervals being classified as

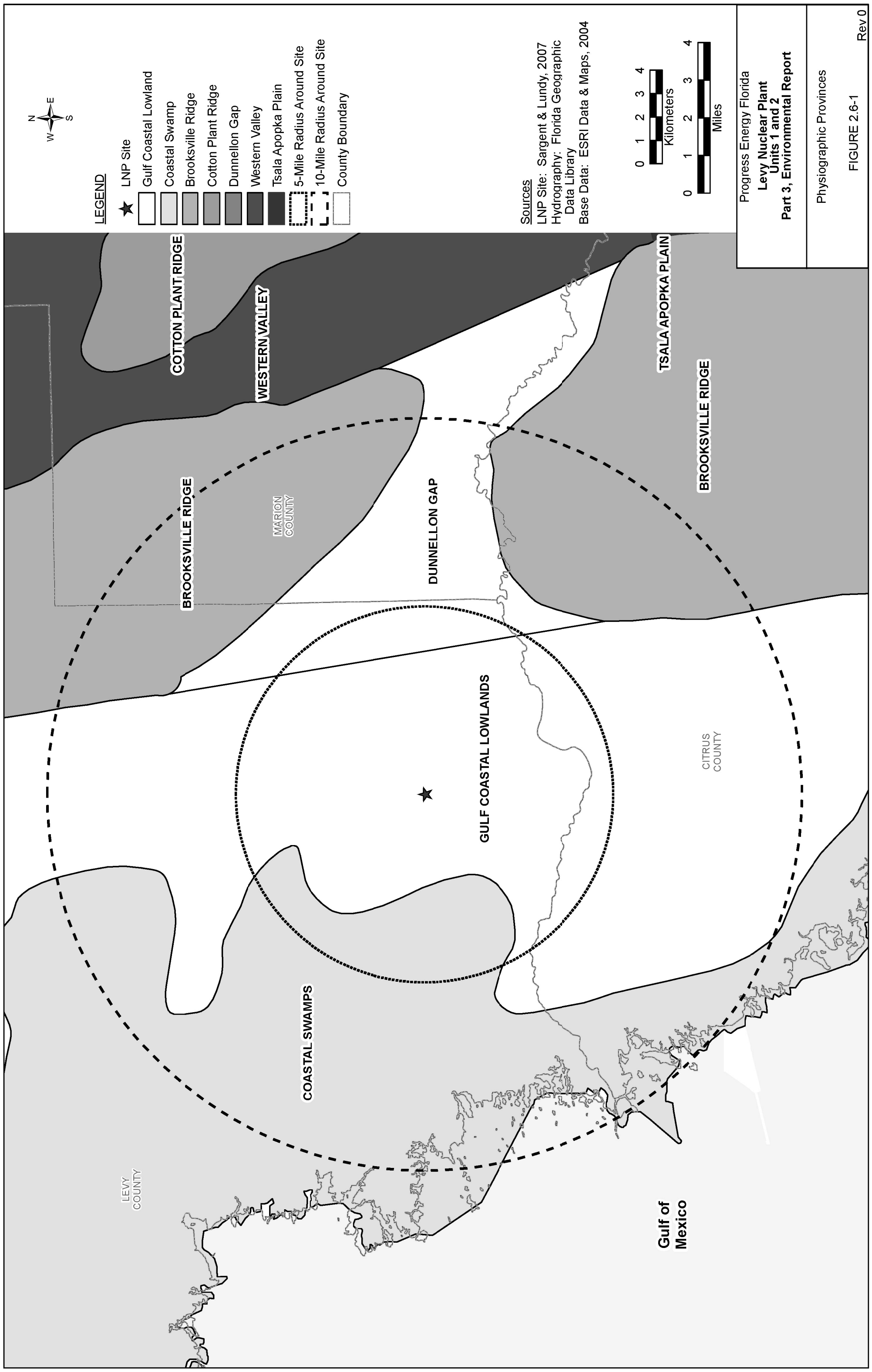


Figure 2-30. Physiographic Provinces in the Vicinity of the LNP Site (PEF 2009a)

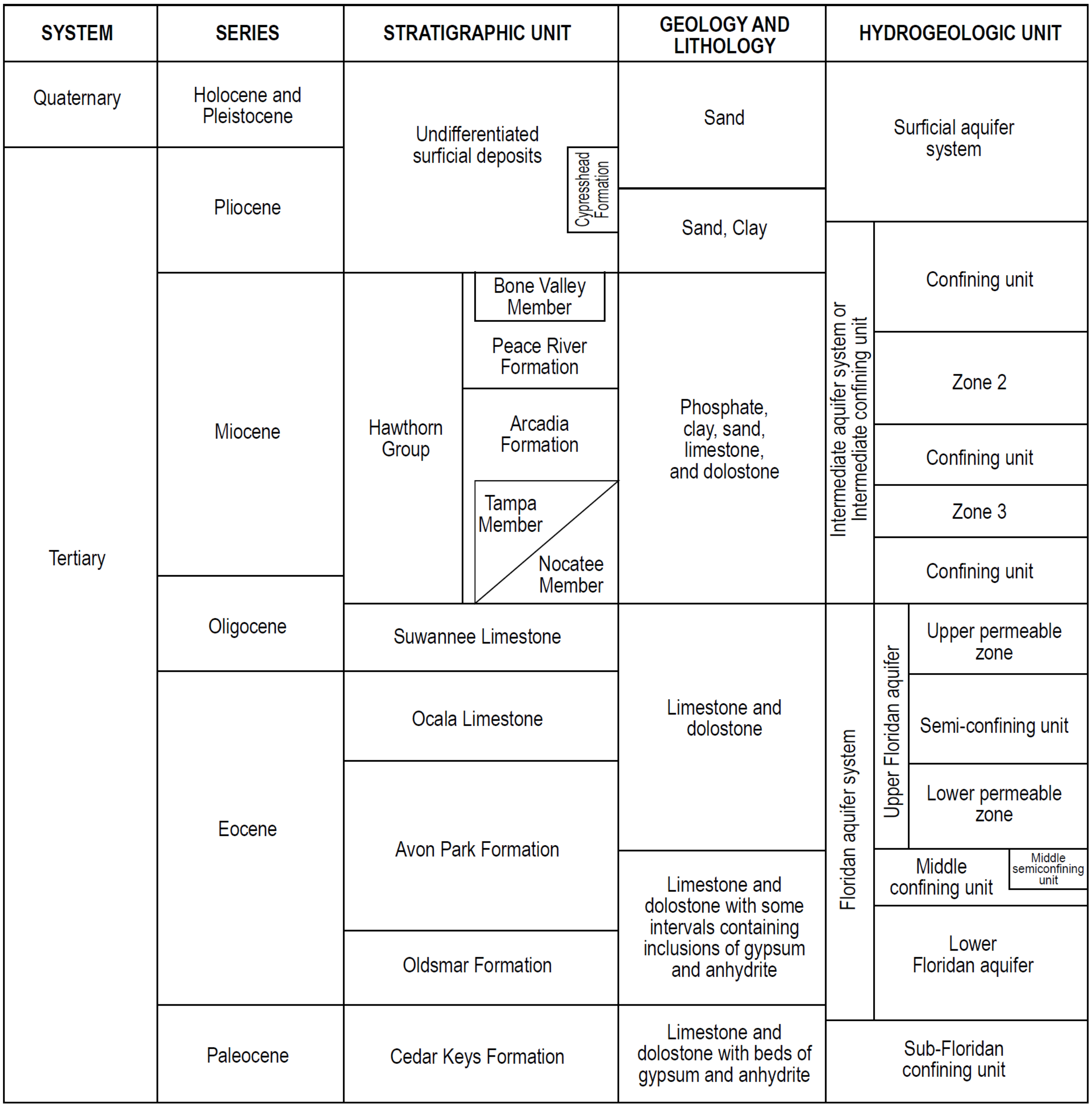


Figure 2-31. Relationship of Stratigraphy and Hydrogeologic Units in West-Central Florida (PEF 2009a)

confining or semi-confining units. These confining units can be composed of clays, fine-grained limestones, or limestone/dolomite with pore space infilled with anhydrite or quartz.

Near the LNP site, the Floridan aquifer is overlain by unconsolidated materials that are a less important source of water. As described by the applicant (PEF 2009a):

> Surface soils present at the LNP site are undifferentiated Quaternary sands of the Smyrna-Immokalee-Basinger (S1547) Series, described as a loamy fine silica sand and fine silty sand, and are poorly to very poorly drained. The local stratigraphic-hydrostratigraphic sequences at the LNP site consist of Quaternary surficial aquifer deposits lying directly over the Floridan Aquifer limestones and dolostones of the Avon Park Formation. The Upper Floridan Aquifer at the LNP site contains fresh potable water and is separated physically and hydraulically from the underlying Lower Floridan Aquifer by sequences of lower permeability evaporite rock units known as the MCU [middle confining unit], which act as an aquitard.

PEF indicates that, based on a regional study of Florida, there are no faults or other geologic structures of concern in the vicinity of the LNP site, which is consistent with information presented in the USGS Ground Water Atlas (USGS 2000). PEF also indicates that the LNP site is in a region where the limestone is bare or thinly covered, and sinkholes are few, generally shallow, broad, and develop gradually. This interpretation is also consistent with the USGS Ground Water Atlas, which shows transmissivity values in the vicinity of the LNP site that are below the threshold that would be indicative of well-developed karst systems.

Based on a 1988 assessment by the Florida Geological Survey (Lane et al. 1988), mineral resources within the footprint of the LNP site include sand that could be mined as an aggregate material used in the construction industry. Additional mineral resources in the vicinity of the LNP site include dolomite and limestone, which are also mined for use as construction materials.

2.9 Meteorology and Air Quality

The following three sections describe the climate and air quality of the LNP site. Section 2.9.1 describes the climate of the region and area in the immediate vicinity of the LNP Site; Section 2.9.2 describes the air quality of the region; and Section 2.9.3 describes atmospheric dispersion at the site. Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The LNP site has a warm humid climate with short mild winters and long warm and humid summers. While the site is south of the climatological mid-latitude storm tracks (NOAA 2008), occasional outbreaks of cold northern air do produce freezing conditions (LCD 2007). The closest first-order weather stations to the site with long periods of record are Gainesville, Florida, which is located about 44.2 mi northeast of the site, and Tampa, Florida, which is located about 78 mi south of the site. Although it is further from the LNP site, the Tampa station provides a better indication of the general climate because of the close proximity of both this station and the site to the Gulf of Mexico. The site is relatively flat with no topographic features that would alter the regional climate.

The following climatological statistics are derived from local climatological data for Tampa (LCD 2007). Temperatures are more variable in the winter than in the summer because of the differences in air mass source regions. Daytime maximum temperatures range from about 90°F in August to about 70°F in January, while nighttime minimum temperatures range from about 75°F in July and August to about 52°F in January. Monthly average wind speeds range from about 6 mph in the summer to about 7 mph in the winter and early spring. Precipitation is greatest from June through September. Most of the precipitation is associated with thunderstorms that frequently occur in the late afternoon. Snow is rare and generally occurs in small amounts.

The environment around the LNP site is quite humid, and the average relative humidity is always greater than 70 percent, with the lowest values occurring in the spring. The relative humidity also has a large diurnal variation ranging from mid-day values near 65 percent to nighttime values near 88 percent during the summer. Conditions are dryer in the spring when the average mid-day value is near 55 percent, and average nighttime value is near 83 percent. During the winter, nighttime fogs are frequent, and heavy fog (instances in which the visibility is less than 0.25 mi) is observed, on average, 15 days a year.

On a larger scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge in this area (GCRP 2009) has been considered in preparation of this EIS. Projected changes in the climate for the region during the life of the proposed LNP Units 1 and 2 site include an increase in average temperature of 2 to 4°F; a decrease in precipitation in the winter, spring, and summer; and an increase in the fall, and an increase in the frequency of heavy precipitation (GCRP 2009). Changes in climate during the life of proposed Units 1 and 2 could result in either an increase or decrease in the amount of runoff; the divergence in model projections for the southeastern United States precludes a definitive estimate (GCRP 2009).

2.9.1.1 Wind

The prevailing wind direction measured at Tampa is from the south from May through July, and from the northeast during the rest of the year. The wind speed measured at Tampa is nearly constant throughout the year, with slightly smaller wind speeds measured during the summer (LCD 2007). Wind speed and wind direction were measured at the LNP site during the period from February 1, 2007 through January 31, 2009. The prevailing wind directions measured at the site during this period were from the east-northeast and from the west. These wind directions are typical of locations near large bodies of water, such as Tampa, often experience a sea-breeze circulation. This occurs because of differential heating of the water and land, which leads to onshore flow during the day, and offshore flow at night (Stull 1988). In these instances, the average, or prevailing wind direction may mask this variation. An analysis of data collected at the Tampa station in 2007 highlights these effects. Average wind direction is from the northeast (offshore) when considering wind measurements made between midnight and 2:00 a.m. In contrast, average wind direction is from the west (onshore) when measurements are obtained between noon and 2:00 p.m.

2.9.1.2 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme based on temperature differences is set forth in Regulatory Guide 1.23, Revision 1 (NRC 2007b). When the temperature decreases rapidly with height, the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited.

At the LNP site the stability can be computed from the temperature difference measured between 10 and 60 m above the ground at the meteorological tower. Based on these data, neutral or slightly stable conditions (classes D and E, respectively) are found to occur in nearly 50 percent of the total hours. More than 25 percent of the hours are classified as stable and extremely stable conditions (classes F and G, respectively). Extremely, moderately, and weakly unstable conditions (classes A, B, and C, respectively) were found to occur in approximately 25 percent of the hours (PEF 2009a).

2.9.1.3 Temperature

The temperature measured at the 33-ft level of the meteorological tower at the LNP site is considered to be representative of the site. Temperature data from the tower from February 1, 2007 through January 31, 2009 show the daily average temperature ranges from a low of 35°F in January 2008 to a high of 84°F in August 2007. During this 2-year period, the absolute minimum temperature was 21°F and the absolute maximum temperature was 94°F. These temperatures are consistent with long-term values measured at Tampa; the normal daily temperature ranges from 83°F in August to 61°F in January. In addition, on average the daily minimum temperature measured in January is less than 32°F on 1 or 2 days per year (LCD 2007).

2.9.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways. At the LNP site, the humidity is measured using dew-point temperature. During the period of record, from

February 1, 2007 through January 31, 2009, the highest monthly mean dew-point temperature was 73°F measured in August 2007 and the lowest monthly mean dew-point temperature was 45.4°F measured in January 2009 (PEF 2008a, 2009a).

The normal amount of annual precipitation received at Tampa is 44.77 in. The majority (58 percent) of the annual rainfall is associated with thunderstorms that frequently occur from June through September. On average during this period, between 11 and 20 days per month have thunderstorms. While there is generally sufficient rainfall, Florida is susceptible to droughts. Recent periods of droughts include the early 1970s, the early 1980s, 1989–1990, and 1999–2001 (FDEP 2007).

2.9.1.5 Severe Weather

The LNP site can experience severe weather in the form of thunderstorms, hurricanes, and tornadoes. Tampa experiences thunderstorms approximately 81 days a year. There is a large annual cycle to the thunderstorms, which are more common in the summer and early fall than during other times of the year. The thunderstorm observations at Tampa include cases in which thunder is heard by the observer in the 15 minutes preceding the observations (Glickman 2000). A county-by-county database of severe weather is maintained by the NOAA. A total of 23 severe thunderstorms (defined to have a wind speed greater than 50 knots) were observed in Levy County during the period from 1988 to 2008. The tornado database indicates that 22 tornadoes, ranging in strength from F0 to F2 were reported in Levy County. Based on the analysis presented in NUREG/CR-4461, Rev. 2 (NRC 2007d), the probability of a tornado striking the LNP site is 1.16×10^{-4} $year^{-1}$. Due to its location near the Gulf of Mexico, Levy County is susceptible to hurricanes and tropical storms. During the period 1977 through 2007, one hurricane and seven tropical storms passed within approximately 50 mi of the LNP site (NOAA 2009c). The lone hurricane was Hurricane Gordon, which was a category 1 hurricane when it passed near the site. While most instances of severe weather near the LNP site are associated with thunderstorms, tornadoes, and hurricanes, there have been cases of severe cold weather. During these events the temperature can drop to 10 to 20°F.

2.9.2 Air Quality

The LNP site is in Levy County, Florida, which is in the northern part of the West Central Florida Intrastate Air Quality Control Region (AQCR) (40 CFR 81.96). Adjacent AQCRs include the Jacksonville-Brunswick Interstate AQCR, Central Florida Intrastate AQCR, and Southwest Florida Intrastate AQCR. All of the counties in these AQCRs near the LNP site are in compliance with the National Ambient Air Quality Standards (NAAQSs) as shown in 40 CFR 81.310.

The FDEP operates a network to measure the concentration of carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide throughout the state. The monitoring sites are concentrated in areas with large population densities. The monitoring sites closest to the LNP site are located to the east of the site in Alachua and Marion Counties. The Air Quality Index (AQI) is a standard method for reporting air-pollution levels for the general public. The AQI is based on comparison of the concentrations of six pollutants with the NAAQSs. The six pollutants are ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter smaller than 10 microns, and particulate matter smaller than 2.5 microns. The air-pollution level for each day is placed in one of six categories based on the AQI. In order of decreasing air quality, the categories are Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous. The AQI is not computed for Levy County, but is for several adjacent counties, including Alachua, Marion, and Citrus Counties. In 2007, the last complete year for which data are available, only 1 day in the three counties was classified as bad as Unhealthy, and only 9 days in the three counties were classified as Unhealthy for Sensitive Groups. In nearly all of the cases ozone was the main contributor to the AQI.

There is only one mandatory Class 1 Federal Area (where visibility is protected) within 100 mi of the LNP site. The Chassahowitzka Class I area is located approximately 25 mi south of the site. Two other Class 1 Areas – the St. Marks Class I area and the Okefenokee Class 1 area – are located approximately 110 mi northwest and 110 mi north-northeast of the site, respectively.

2.9.3 Atmospheric Dispersion

The NRC staff visited the meteorological measurement system at the site and reviewed the available information on the design of the meteorological measurements program and evaluated data collected by the program. Based on this information, the NRC staff concludes that the program provides data that represent the affected environment onsite meteorological conditions as required by 10 CFR 100.20. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34, 10 CFR Part 50, Appendix I, and 10 CRF 52.79.

2.9.3.1 Short-Term Dispersion Estimates

PEF calculated short-term dispersion estimates using 2 years of onsite meteorological data (from February 1, 2007 through January 31, 2009). These estimates, which were provided in Section 2.7.6.2 of the ER (PEF 2009a), were based on distances to the exclusion area boundary (EAB) and outer boundary of the LPZ as defined in Section 2 of the ER (PEF 2009a). Based on its review of the revised dispersion estimates, the NRC staff determined that the revised estimates were overly conservative and did not appropriately reflect realistic dispersion conditions at the site. Consequently, the NRC staff calculated site-specific short-term dispersion estimates for the EIS design basis accident (DBA) review.

The NRC staff's short-term dispersion estimates for use in DBA calculations are listed in Table 2-36. They are based on the PAVAN computer code (Bander 1982) calculations of 1-hour and annual average atmospheric dispersion (χ/Q) values from a joint frequency distribution of wind speed, wind direction, and atmospheric stability. These values were calculated for the shortest distances from a release boundary envelope that encloses the LNP Unit 1 or Unit 2 release points to the EAB and to the LPZ. The 50-percent EAB χ/Q value listed in Table 2-36 is the median 1-hr χ/Q, which is assumed to persist for 2 hours. The 50-percent LPZ χ/Q values listed in Table 2-36 were determined by logarithmic interpolation between the median 1-hour χ/Q, which was assumed to persist for 2 hours, and the annual average χ/Q following the procedure described in Regulatory Guide 1.145 (NRC 1983).

Table 2-36. Atmospheric Dispersion Factors for Proposed Unit 3 and 4 Design Basis Accident Calculations

Time Period	Boundary	χ/Q (s/m^3)
0 to 2 hours	Exclusion Area Boundary	3.60×10^{-5}
0 to 8 hours[a]	Low Population Zone	5.97×10^{-6}
8 to 24 hours[a]	Low Population Zone	4.69×10^{-6}
1 to 4 days[a]	Low Population Zone	3.72×10^{-6}
4 to 30 days[a]	Low Population Zone	2.79×10^{-6}

(a) Times are relative to beginning of the release to the environment.

2.9.3.2 Long-Term Diffusion Estimates

Long-term dispersion estimates for use in evaluation of the radiological impacts of normal operations were calculated by PEF using the XOQDOQ computer code (Sagendorf et al. 1982) and 2 years of onsite meteorological data (February 1, 2007 through January 31, 2009) (PEF 2009a). This code implements the guidance set forth in Revision 1 of Regulatory Guide 1.111 (NRC 1977) for estimation of χ/Q and deposition factors (D/Q) for use in evaluation of the consequences of normal reactor operations. The results of the PEF calculations are presented in **Table 2-37** for receptors of interest, including the closest point of the EAB, the LPZ, the nearest residence, the closest milk cow, the closest milk goat, the closest meat animal, and the closest vegetable garden. Tables 2.7-58 through 2.7-61 in the ER presents annual average atmospheric dispersion and deposition factors for 11 distances between 0.25 and 50 mi from the release point for each of 16 direction sectors.

2.9.4 Meteorological Monitoring

A meteorological monitoring program has existed at the LNP site since February 2007. The initial instrumentation was installed to provide onsite meteorological information for the licensing of LNP, and it continues to be operated in support of LNP Units 1 and 2. The instrumentation is described in detail in Section 6.4 of the ER (PEF 2009a). The tower and instrumentation comply with the requirements listed in Regulatory Guide 1.23, Revision 1 (NRC 2007b). Wind

Table 2-37. Maximum Annual Average Atmospheric Dispersion and Deposition Factors for Evaluation of Normal Effluents for Receptors of Interest

Receptor	Downwind Sector	Distance (mi)	No Decay χ/Q (s/m^3)	2.26-Day Decay χ/Q (s/m^3)	8-Day Decay χ/Q (s/m^3)	D/Q (1/m^2)
EAB	WSW	0.83	1.9×10^{-5}	1.8×10^{-5}	1.7×10^{-5}	1.3×10^{-8}
LPZ	WSW	3.00	3.5×10^{-6}	3.3×10^{-6}	2.8×10^{-6}	1.4×10^{-9}
Nearest Residence	WSW	1.70	7.3×10^{-6}	7.0×10^{-6}	6.0×10^{-6}	3.7×10^{-9}
Milk Cow[(a)]	WSW	5.00	1.9×10^{-6}	1.6×10^{-6}	1.3×10^{-6}	5.5×10^{-10}
Milk Goat[(a)]	WSW	5.00	1.9×10^{-6}	1.6×10^{-6}	1.3×10^{-6}	5.5×10^{-10}
Meat Animal[(a)]	WSW	5.00	1.9×10^{-6}	1.6×10^{-6}	1.3×10^{-6}	5.5×10^{-10}
Veg. Garden[(a)]	WSW	1.70	7.3×10^{-6}	7.0×10^{-6}	6.0×10^{-6}	3.7×10^{-9}

(a) If nearest receptor location is further than 5 mi from the LNP, then 5 mi was assumed as the distance to the receptor.

speed and wind direction ambient temperature, delta-temperature, and humidity are measured at two levels: 10 m and 60 m above the ground. Calibration of the datalogger, wind sensors, and rain gauge is completed semi-annually. Calibration of the sensors used to measure pressure and dew-point temperature is performed annually. The thermistors used for the temperature and delta-temperature measurements are quite stable, and routine calibration is not required. The ambient and differential measurements are, however, compared on a regular basis to identify errors.

2.10 Nonradiological Environment

This section describes aspects of the environment at the LNP site and within the vicinity of the site associated with nonradiological human health impacts. The section provides the basis for evaluation of impacts on human health from the building and operation of proposed LNP Units 1 and 2. Building activities have the potential to affect public and occupational health, create impacts from noise, and affect the health of the public and workers from transportation of construction materials and personnel to the LNP site. Operation of the proposed Units 1 and 2 has the potential to affect the public and workers at the LNP site from operation of the cooling system, noise generated by operations, electromagnetic fields (EMFs) generated by transmission systems, and transportation of operations and outage workers to and from the LNP site.

2.10.1 Public and Occupational Health

This section describes potential impacts on public and occupational health at the LNP site and vicinity associated with air quality, occupational injuries, and etiological agents (i.e., disease causing microorganisms).

2.10.1.1 Air Quality

Public and occupational health can be affected by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996, 1999[(a)]). Air quality for Levy County is discussed in Section 2.9.2. Fugitive dust may be generated during land clearing and construction activities, as well as by exhaust from construction equipment (PEF 2009a). Exhaust emissions from construction equipment are predicted to include particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), nitrogen oxides, CO, and volatile organic compounds. PEF states that the emissions are likely to be similar to those from other large construction projects, and air quality impacts beyond the site boundary are likely to be minimal owing to the large extent of the site (3105 ac) and long distances from the locations where the bulk of construction would occur to the site boundaries (PEF 2009a). The nearest accessible area is approximately 1 mi from the construction site for proposed LNP Units 1 and 2, and the nearest residences are 1.6 mi to the northwest and 1.7 mi to the west-southwest, respectively (PEF 2009a).

Exhaust emissions during normal plant operations associated with onsite vehicles and equipment as well as from commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire pump engines), and other nonradiological emission-generating sources (e.g., storage tanks) or activities are not expected to be a significant source of criteria pollutant emissions. Diesel generators and supporting equipment would be in place for emergency use only, but would be started regularly to confirm that the systems are operational. Emissions from nonradiological air-pollution sources are permitted by FDEP and Levy County.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation, and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. The U.S. Bureau of Labor Statistics (BLS) provides reports that account for occupational injuries and illnesses as total recordable cases, which include cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid (BLS 2010a). The State of Florida also tracks the annual incidence rates of injuries and illnesses for electric power generation, transmission, and distribution workers (BLS 2010b). These records of statistics are used to estimate the likely

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(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

number of occupational injuries and illnesses for operation of Units 1 and 2 and predict the likely number of cases for the proposed new units.

2.10.1.3 Etiological Agents

Public and occupational health may be affected by activities at the LNP site that encourage the growth of disease-causing microorganisms (etiological agents). Thermal discharges from proposed Units 1 and 2 through the CREC into the Gulf of Mexico have the potential to increase the growth of etiological agents (thermophilic microorganisms) (PEF 2009a). The types of organisms of concern for public and occupational health include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp. and *Vibrio* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels (NRC 1996).

Vibrio spp. are a concern for human health because these theromophilic bacteria are commonly found in coastal marine waters and can be associated with filter-feeding shellfish (e.g., oysters). People can be exposed to the bacteria through activities such as swimming, diving, or wading in the water, as well as through consumption of contaminated shellfish. *Vibrio cholera*e causes the disease cholera, which is an acute, diarrheal illness. Other *Vibrio* species do not cause cholera (e.g., *V. vulnificus* and *V. parahaemolyticus*), however, exposure to the bacteria can cause watery diarrhea and abdominal cramps as well as skin infections. Cholera and non-cholera illnesses caused by *Vibrio* spp. can be fatal. CDC reports that the most common cases of illness are from exposure to recreational waters in the Gulf Coast, and Florida had the highest number of cases from 2003 – 2006 (CDC 2006, 2008a). Over the past 10 years, Levy County reported no cases of cholera and 5 cases of non-cholera *Vibrio* illnesses; and Citrus County reported no cases of cholera and 10 cases of non-cholera *Vibrio* illnesses (FDOH 2010a).

Primary amoebic meningoencephalitis (PAM) associated with exposure to *Naeglaeria fowleri* and other strains is a potentially serious concern because of its high mortality rate. The U.S. Centers for Disease Control and Prevention (CDC) report that a total of 27 cases of PAM linked to Naegleria sp. occurred in the United States in the years 2000–2007 (CDC 2008b). All of the cases occurred in southern states (including three fatal cases in Florida in 2007), and 95 percent of the reported cases occurred in the summer months. The most common sources of exposure were warm-water lakes and rivers. In the three Florida cases that occurred in 2007, the presumed sources of exposure were a privately owned water sports facility, a “local lake” (identity not specified), and an apartment swimming pool or “drainage ditches and canals.” None of the cases described by CDC (CDC 2004, 2006, 2008a, b) attribute exposures to waterbodies affected by thermal discharges from power plants or other industrial operations, although the described cases are thought to represent only a small percentage of the national total. Yoder et al. (2010), in an analysis based on data from CDC and other sources, report that a total of 28 cases of PAM were reported in the United States in the years 2000–2008, with 6 cases occurring in Florida; 1 in 2000, 2 in 2002, and 3 in 2007. The majority of cases reported in the United States (73.6 percent) were associated with exposures in "lakes, rivers, and reservoirs." No data are provided as to whether thermal discharges played a role in any of the cases.

A fatal case of PAM was reported in a 22-year-old man who attended a water sports complex in Seminole County, Florida in September 2009, and another case was reported in a 10-year-old boy two weeks later. Lake Arietta in Polk County was identified as the most likely exposure source in the latter case (Bodiger 2010). Lake Arrieta is located in a residential area and not affected by heat releases from industrial sources. The Levy County Department of Health reports that no cases of PAM have occurred in the county in the last 10 years (Wilson 2010), and the Florida DOH regional epidemiologist reports that there have been no reported cases of PAM in Florida since the two cases discussed above (Bodiger 2010).

Exposure to *Legionella* sp. bacteria can cause Legionnaires' disease, a potentially life-threatening pneumonia, and Pontiac Fever, a flu-like illness. Based on CDC-assembled data, the CDC (2004, 2006, 2008a) reports a total of 18 *Legionella* outbreaks affecting 498 people in 16 states in the years 2001–2006. One outbreak affecting 11 people occurred in Florida. Most of the outbreaks (including the one in Florida) involved exposure to contaminated water in spas or swimming pools. Richardson, et al. (2010) reported that 12 cases of Legionellosis occurred in Seminole County, Florida in 2009. Cases were concentrated in the summer months, and two of the victims were members of the same fitness club, where a swimming pool and shower were identified as potential exposure sources. No common exposure source could be identified for the remaining cases. Overall, the annual rate of legionella infection in the county was approximately double the average over that seen in the previous 5 years. The CDC (2010) reported that 10 cases of Legionnellosis were identified in Florida through May 15, 2010. No additional information was provided regarding locations or potential exposure sources. Data from the Florida department of Health Communicable Disease Frequency Reports (FDOH 2010b) indicates that one case of Legionnellosis occurred in Levy County in 2009 and none through the first three months of 2010; in Citrus County, there were no Legionnellosis cases in 2009 and one case in 2010.

Exposure to *Pseudomonas aeruginosa* may cause skin and ear infections in healthy individuals, and more serious infections in those with compromised immune systems. Fourteen outbreaks of *Pseudomonas*-related disease (mostly skin rashes) were reported in eight states, primarily in the Midwest, in 2001–2006 (CDC 2004, 2006, 2008a).

Exposure to *Shigella* sp. and *Salmonella* sp. can cause gastroenteritis, characterized by fever, abdominal pain, vomiting, and diarrhea. The most common source of exposure to these organisms is through contaminated food, and the U.S. Food and Drug Administration (FDA) reports that approximately 300,000 and 50,000 cases of Shigella- and Salmonella-related gastroenteritis, respectively, occur per year in the United States (FDA 2009a, b). In contrast, only a handful of outbreaks associated with recreational water exposures (four due to Shigella, none due to Salmonella) have been identified in recent years (CDC 2004, 2006, 2008a).

The County Epidemiologist for Levy County indicated that there have been no outbreaks of shigellosis or salmonellosis in Levy County within the past 10 years, although sporadic cases have been reported (Wilson 2010). According to data from Florida's Community Health Assessment Resource Tool Set (CHARTS) (FDOH 2010c), the reported rates of salmonellosis in Levy County for 2006, 2007, and 2008 were 15.3, 27.4, and 31.8 per year per 100,000 population, respectively, compared to state-wide rates of 26.0, 26.8, and 28.2 per year per 100,000 population. During the same years, the reported rates of shigellosis in Levy County were 10.2, 12.4, and 2.4 per 100,000, respectively, compared to statewide rates of 7.3, 12,2, and 4.3 per year per 100,000 population. Based on data from the Florida DOH Communicable Disease Frequency Reports (FDOH 2010b), there were 22 cases of salmonellosis and no cases of shigellosis reported in Levy County in 2009. There have been two cases of salmonellosis and no cases of shigellosis reported in Levy County in the first four months of 2010.

Reported rates of salmonellosis in Citrus county for 2006, 2007, and 2008 were 13.1, 32.7, and 27.4 per year per 100,000 population, respectively, similar to the annual rates for the state as a whole (FDOH 2010c). During the same years, the reported rates of shigellosis in Citrus County were 4.4, 144.3, and 0.0 per 100,000 population, respectively. An investigation by the Florida Department of Health (FDOH 2008) found that the high rate of shigellosis in Citrus County in 2007 (203 total cases) was due to an outbreak centered on daycare centers and elementary schools. Five cases of shigellosis were reported in Citrus County in 2009, and one case has been reported through April 30, 2010 (FDOH 2010b)

2.10.2 Noise

Sources of noise at the LNP site would be associated with heavy equipment during the construction phase and mechanical draft cooling towers and cooling pumps during operation of Units 1 and 2. Another source of noise during facility operation would be the CWIS makeup-water pump house that is located adjacent to the CFBC, approximately 3.5 mi south of the center of the main plant site near CR-40. Transmission lines and substations may produce noise from corona discharge – the electrical breakdown of air into charged particles.

The LNP site is located on 3105 ac of land surrounded by mixed rural-agricultural land in an area of low-population density. The closest noise-sensitive receptors were identified as being the residences located approximately 1.6 mi to the northwest and 1.7 mi to the west-southwest of the center of the project site. Individuals participating in recreational activities on the Inglis Island Trail in Goethe State Forest might also be affected by construction noise (PEF 2009a). The rural surroundings and enclosure of noise-generating equipment in facilities help to mitigate onsite noise perceived by offsite receptors.

Activities associated with building the new units at the LNP site would have peak noise levels in the range of 100 to 110 on the A-weighted scale (dBA). As illustrated in Table 2-38, noise strongly attenuates with distance. A decrease of 10 dBA in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the source, these peak noise levels would generally decrease to the 80-to-95-dBA range and at distance of 400 ft, the peak noise levels would generally be in the 60-to-80-dBA range. For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler 1982).

Table 2-38. Construction Noise Sources and Attenuation with Distance

Source	Noise Level (peak)	Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84–89	78–83	72–77	66–71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80–89	74–82	68–77	60–71
Dozer	107	87–102	81–96	75–90	69–84
Generator	96	76	70	64	58
Crane	104	75–88	69–82	63–76	55–70
Loader	104	73–86	67–80	61–74	55–68
Grader	108	88–91	82–85	76–79	70–73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et. al 1980

Federal regulations governing noise associated with the activities at the LNP site are limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910, *Occupational Health and Safety Standards*, and 40 CFR Part 204, *Noise Emission Standards for Construction Equipment*. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. The Levy County Noise Ordinance (Levy County Code 50-349) limits sound levels experienced by offsite receptors due to industrial activities. For residential, rural agricultural, and commercial districts, the maximum allowable noise level at the property line is 65 dBA for the hours of 7 a.m. to 10 p.m. For industrial districts, the maximum allowable noise level is 75 dBA at all times. Allowable noise limits are lower from 10 p.m. to 7 a.m. in residential areas (55 dBA) and rural districts (60 dBA).The CWIS makeup-water pump house would be located adjacent to the CFBC, approximately 3.5 mi south of the center of the main plant site near County Road (CR) 40 close to the border with Citrus County.

2.10.3 Transportation

The highway and rail transportation network surrounding the LNP site is shown in Figure 2-1 and Figure 2-2. The major highway located near the LNP site is US-19/US-98, which runs north to south near the Gulf of Mexico coastline. I-75, the closest interstate highway, is 26.5 mi east of the LNP site. Major access roads to the LNP site include US-19, CR-336, and CR-40. US-19 links the communities of Inglis, Lebanon Station, Gulf Hammock, Otter Creek, Chiefland, and Fanning Springs in Levy County. CR-40 connects Citrus Springs to Inglis at US-19 south of the LNP site, and CR-336 connects Citrus Springs to Lebanon Station at US-19 north of the LNP site.

Access to the site is proposed through two driveways on US-19 and a heavy-haul road intersection crossing CR-40. The northern US-19 driveway is proposed as a "construction only" driveway, while the southern US-19 driveway is proposed as the main site access upon completion of construction. The heavy-haul road would be constructed specifically to transport equipment and materials between the barge slip access road and the LNP site, and extends north from CR-40 to the LNP site. The barge slip access road would extend from CR-40 south to the anticipated barge slip. The new slip would be located on the northern bank of the CFBC at the end of the proposed barge slip access road.

Two railroad lines are located within 10 mi of the LNP site. The lines include an abandoned track with only the rail bed remaining, which is located northeast of the site and north of SR-336, and an active railroad line operated by CSX, which is located southeast of the LNP site. The CSX line runs from the City of Crystal River northeast to the City of Dunnellon.

2.10.4 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMFs. Public and worker health can be compromised by acute and chronic exposure to EMFs from power transmission systems, including switching stations (or substations) onsite and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency. In comparison, television transmitters have frequencies of 55 to 890 MHz and microwaves have frequencies of 1000 MHz and greater (NRC 1996).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 1996). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, storing the electric charge, but isolated from the ground. A person standing on the ground can receive an electric shock from coming into contact with such an object because of the sudden discharge of the capacitive charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code criteria and adherence to the standards for transmission systems regulated by the FDEP (Fla. Admin. Code. 62-814.450(3)).

Long-term or chronic exposure to power transmission lines have been studied for several years. These health effects were evaluated in the Generic Environmental Impact Statement (GEIS) (NRC 1996) for nuclear power in the United States, and are discussed in the ER (PEF 2009a). The GEIS (NRC 1996) reviewed human health and EMFs and concluded the following:

> The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.

2.11 Radiological Environment

Proposed LNP Units 1 and 2 would be located on a greenfield site. Consequently the radiological environment of the LNP site has not been characterized. However, the LNP site is located 9.6 mi northeast of CREC Unit 3 and both facilities are operated by PEF. A radiological environmental monitoring program (REMP) has been in place for the CREC Unit 3 site since operations began in 1977. The REMP includes monitoring of the airborne-exposure pathway, direct-exposure pathway, water-exposure pathway, aquatic-exposure pathway from the Gulf of Mexico, and the ingestion-exposure pathway in a 5-mi radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi away.

The State of Florida Department of Health, Bureau of Radiation Control (BRC), performs sampling of the facility environs for PEF. The State also analyzes environmental samples, participates in the Inter-laboratory Comparison Program, and performs the annual land-use census. Radiological releases are summarized in an annual radiological environmental operating report crafted by BRC and transmitted by PEF to the NRC. Measured values are within predicted ranges of background radioactivity (PEF 2007, 2008b). The staff review of these reports found no indication of radiological consequence associated with the operation of CREC Unit 3. Two years prior to the operation of LNP Unit 1, a preoperational radiological monitoring would be used to confirm the baseline for local environmental conditions along the pathways of exposure discussed in Section 5.9.1.

2.12 Related Federal Projects and Consultation

The staff reviewed the possibility that activities of other Federal agencies might affect the environment affected by the granting of COLs to PEF at the LNP site. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS. These cumulative impacts are discussed in more detail in Chapter 7. As discussed in Chapter 1, the USACE is a cooperating agency for preparation of this EIS.

Federal lands within a 50-mi radius of the LNP site include the following:

- Ocala National Forest in Lake, Marion, and Putnam Counties
- Lower Suwannee National Wildlife Refuge in Dixie and Levy Counties
- Chassahowitzka National Wildlife Refuge in Citrus and Hernando Counties
- Cedar Keys National Wildlife Refuge in Levy County
- Cummer Sanctuary in Levy County
- Subtropical Agricultural Research Station in Hernando County
- Plant Materials Center in Hernando County
- Crystal River National Wildlife Refuge in Citrus County.

The 23,578-ac Chassahowitzka Wilderness is within the 50-mi region, but there are no wild and scenic rivers within the region. There are no Federally recognized Native American Tribal reservations within the region (PEF 2009a).

The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain the comments from any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing this EIS, the NRC consulted with other Federal agencies, Tribal contacts, and State and local agencies. A list of key consultation correspondence is provided in Appendix F.

2.13 References

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3.0 Site Layout and Plant Description

The site of proposed Levy Nuclear Plant (LNP) Units 1 and 2 is located in rural Levy County, Florida. Progress Energy Florida, Inc. (PEF) applied to the U.S. Nuclear Regulatory Commission (NRC or the Commission) for combined construction permits and operating licenses (COLs) for the two new units. On June 2, 2008, PEF submitted a Site Certification Application to the Florida Department of Environmental Protection (FDEP) (PEF 2008). The U.S. Army Corps of Engineers (USACE) received a copy of this application on June 30, 2008. In its March 16, 2009, Public Notice (USACE 2009), the USACE stated that the Environmental Resource Permit application contained in the Site Certification Application, along with its supporting documents, make up the Department of the Army permit application to affect waters of the United States. Conditions of Certification for LNP Units 1 and 2, associated facilities, and transmission lines were issued on August 26, 2009 and subsequently modified on January 12, 2010 and February 23, 2010 (FDEP 2010a). The site is approximately 44 mi southwest of Gainesville and approximately 30 mi west of Ocala, Florida. It is 7.9 mi from the Gulf of Mexico and 9.6 mi from the Crystal River Energy Complex (CREC), an energy facility also owned by PEF (2009a).

This chapter describes the key plant characteristics that are used to assess the environmental impacts of the proposed actions. The information is drawn primarily from PEF's Environmental Report (ER) (PEF 2009a), its Final Safety Analysis Report (FSAR) (PEF 2009b), the USACE's Public Notice (USACE 2009), and supplemental documentation from PEF, as referenced.

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment of the LNP site and its vicinity, this chapter describes the physical layout of the proposed plant. This chapter also describes the physical activities involved in building and operating the plant and associated transmission lines. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into five sections. Section 3.1 describes the external appearance and layout of the proposed plant. Section 3.2 describes the major plant structures, systems, and components (SSC) and distinguishes those that interface with the environment from those that do not interface with the environment or that interface with the environment temporarily. Section 3.3 describes the activities involved in building or installing each of the major plant SSC. Section 3.4 describes the operational activities of the plant SSCs that interface with the environment. References cited are listed in Section 3.5.

3.1 External Appearance and Plant Layout

The 3105-ac site (PEF 2009a) identified as the location of the proposed LNP has been used as a commercial forest plantation (pine tree production and harvesting operations) for over a century. The two proposed reactors and associated support buildings would occupy land near the center of the site. The site, including the planned footprint for proposed LNP Units 1 and 2, is shown in Figure 3-1.

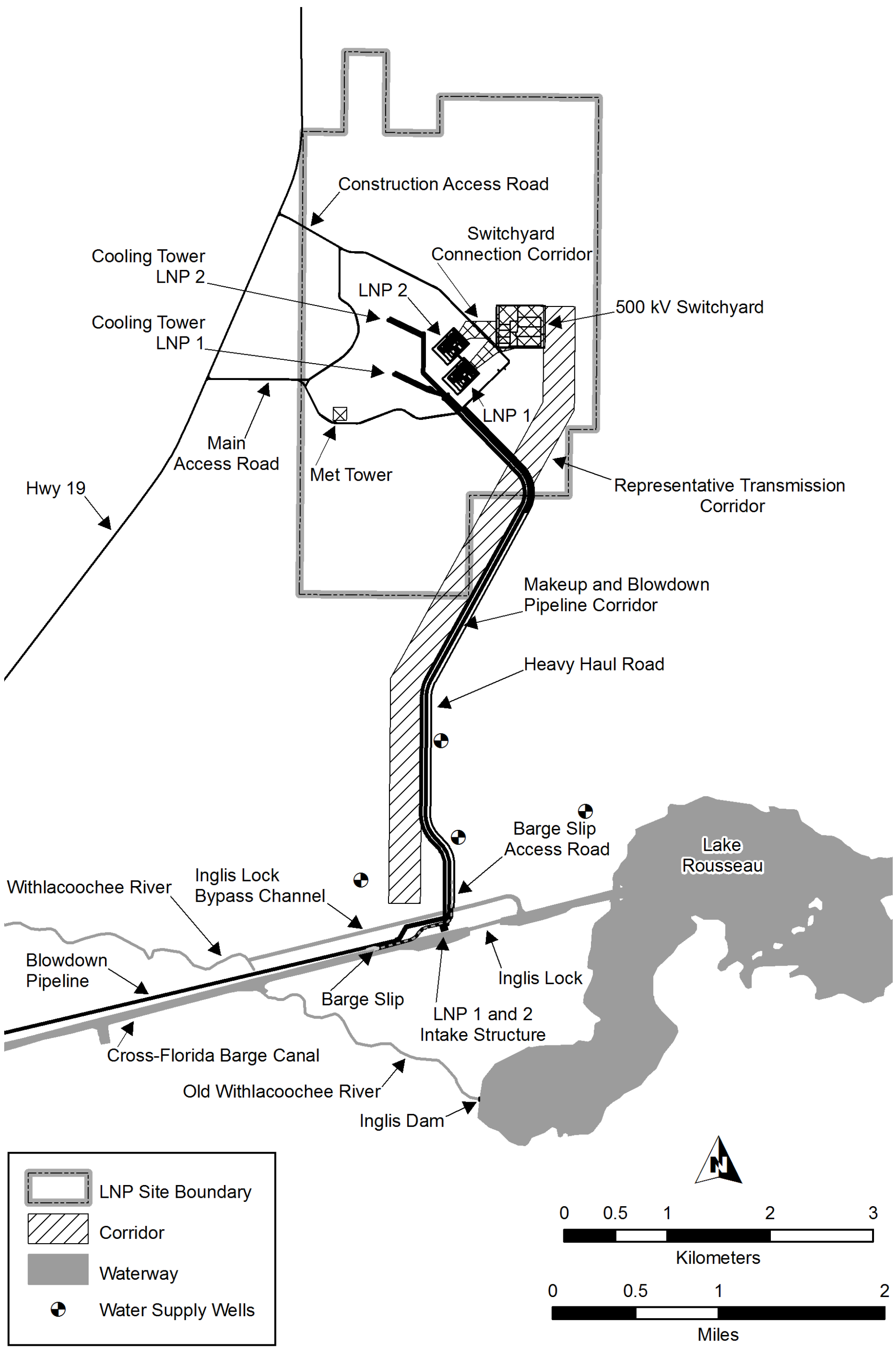

Figure 3-1. Proposed LNP Site Footprint (modified from PEF 2009a)

The containment vessel, shield building, and auxiliary building make up the "nuclear island," which is one of five principal structures of the standard Westinghouse Electric Company, LLC (Westinghouse) AP1000 nuclear power reactor design (Westinghouse 2008) proposed for LNP Units 1 and 2. The other four principal structures of an AP1000 unit are the turbine, diesel generator, radwaste facility, and annex buildings (PEF 2009a).

The proposed location of LNP Units 1 and 2 would have a design site grade of 50 ft North American Vertical Datum 1988 (NAVD88) (PEF 2009a). Each reactor containment structure for the AP1000 is approximately 225 ft high and 130 ft in diameter. Each reactor unit is supported by a multicell mechanical draft cooling tower that is approximately 1000 ft long and 56 ft high (PEF 2009a). A conceptual drawing with proposed LNP Units 1 and 2 superimposed on the site is shown in Figure 3-2.

3.2 Proposed Plant Structures, Systems, and Components

This section describes each of the major plant structures: the reactor power system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the discussion of the impacts of building the proposed Units 1 and 2 in Chapter 4. Only the structures that interface with the environment are important to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power Conversion Systems

PEF has proposed building and operating two Westinghouse AP1000 reactor steam electric generating systems at the LNP site. On January 27, 2006, the NRC issued the final design certification rule for the AP1000 in the *Federal Register* (71 FR 4464) based on Revision 15 of the AP1000 Design Control Document (DCD) (Westinghouse 2005). Each applicant or licensee intending to construct and operate a plant based on the AP1000 design may do so by referencing its design certification rule, as set forth in Appendix D to Title 10 of the Code of Federal Regulations (CFR) Part 52.

Westinghouse is requesting to amend the AP1000 DCD. As mentioned in Section 1.1.4, the reactor design referenced in the application is Revision 17 of the certified design (Westinghouse 2008). The amended application is currently undergoing review. The status of the amended DCD review is available at www.nrc.gov. Each AP1000 reactor is connected to two steam generators that transfer heat from the reactor core, converting feed water to steam that drives high-pressure and low-pressure turbines, thereby creating electricity. Steam that has passed through the turbines is condensed back to water that is heated and pumped back to the steam generators, repeating the cycle. The AP1000 design has a thermal power rating of 3415 MW(t), with a design gross-electrical output of approximately 1200 MW(e). The expected net electrical output for each unit would be greater than 1000 MW(e) (PEF 2009a). Figure 3-3 is an illustration of the reactor power-conversion system.

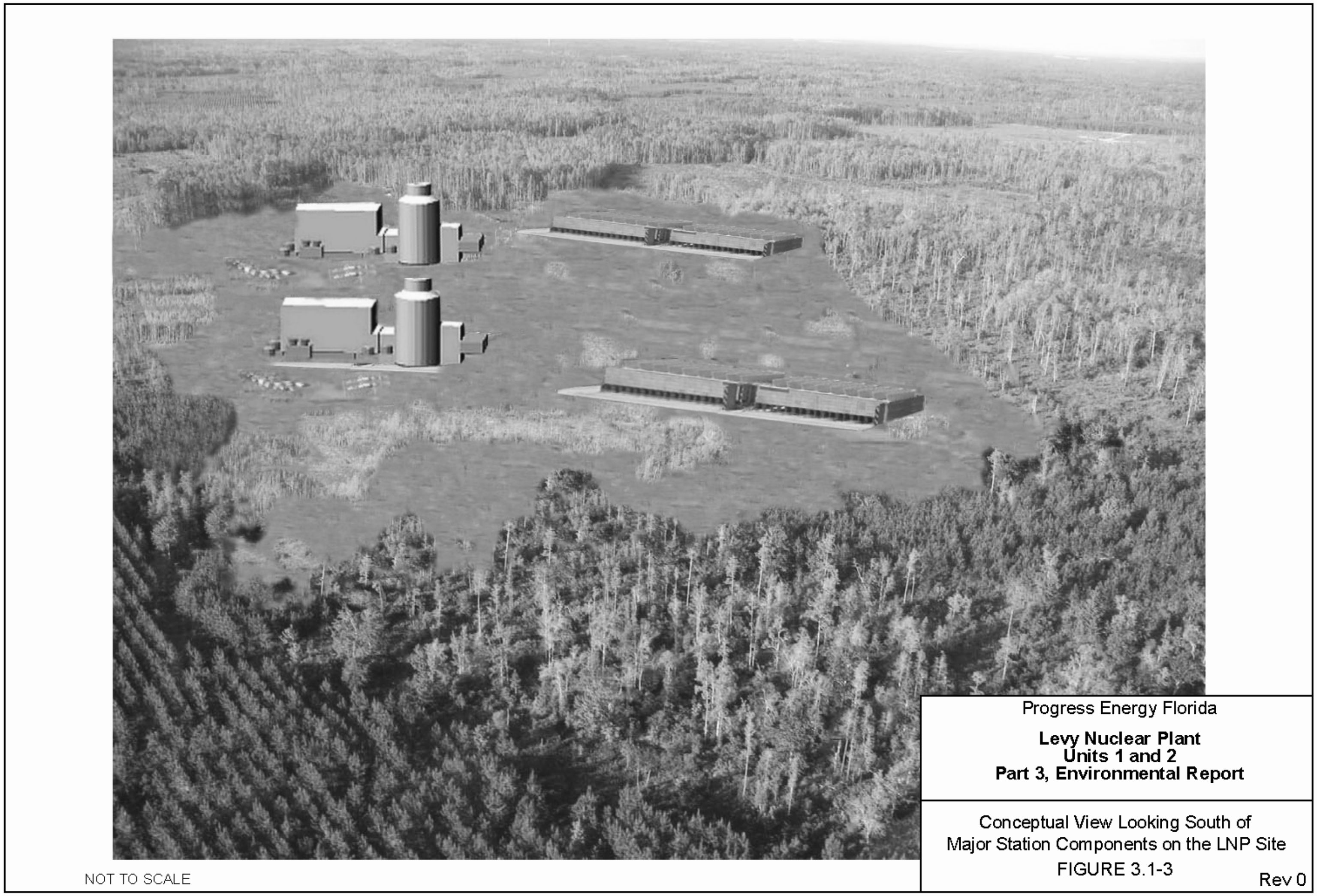

Figure 3-2. Conceptual Drawing with the Proposed Units 1 and 2 Superimposed on the Proposed Site (PEF 2009a)

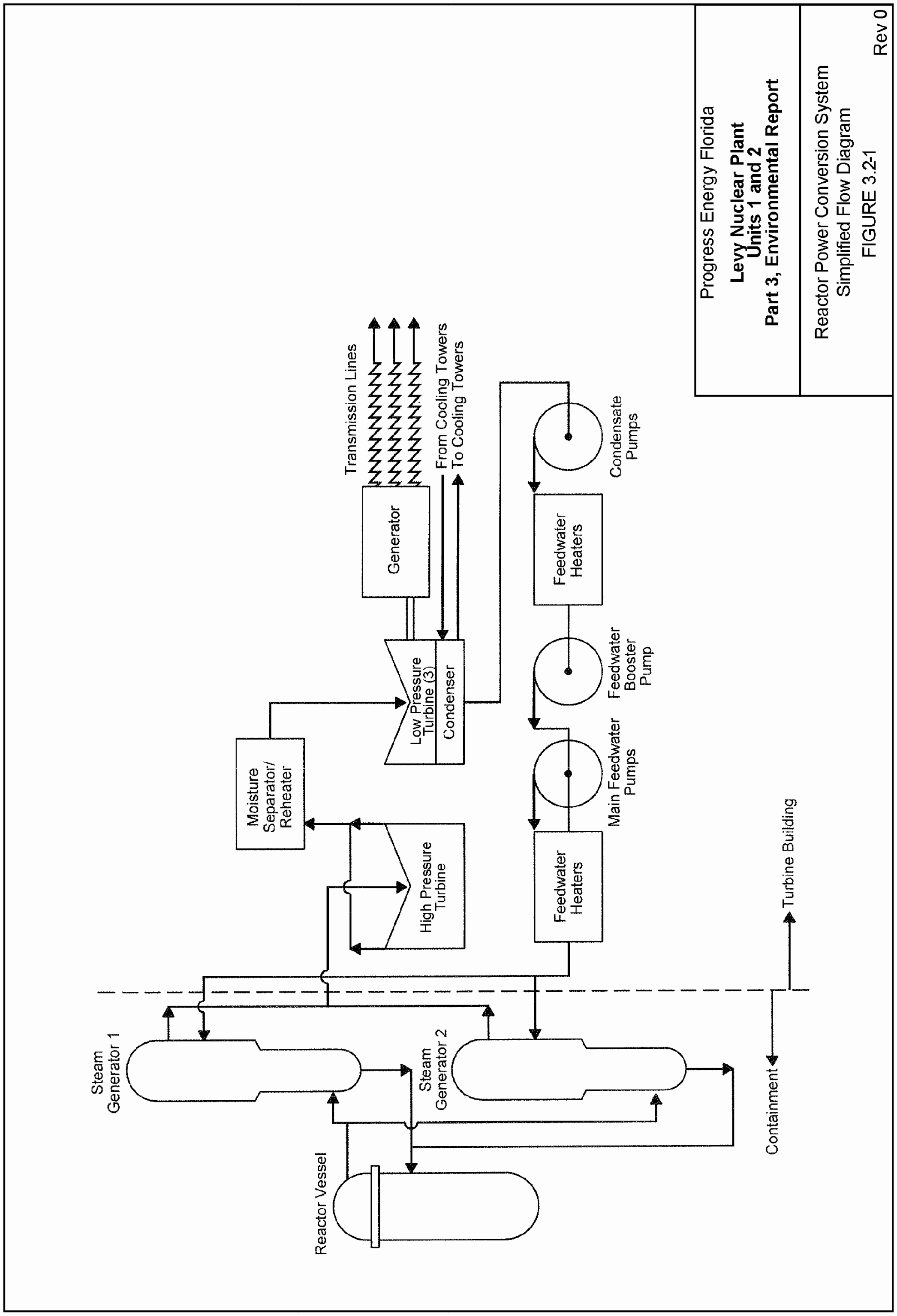

Figure 3-3. Simplified Flow Diagram of the Reactor Power Conversion System (PEF 2009a)

3.2.2 Structures, Systems, and Components with a Major Environmental Interface

The review team (composed of NRC staff, its contractor staff, and USACE staff) divided the plant structures, systems, and components into two primary groups: those that interface with the environment and those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structures, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere from the cooling towers. The interaction of structures, systems, or components with environmental interfaces are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction, and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that do not affect the environment are not relevant to a National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321, et seq.) review and are not discussed further in this EIS. However, such internal processes are considered by the NRC staff in the Westinghouse AP1000 design certification documentation and in other NRC safety reviews of the PEF COL application. This section describes the structures, systems, and components that have a significant plant-environment interface.

The remaining structures, systems, and components are discussed in Section 3.2.3, inasmuch as they may be relevant in the review team's consideration of environmental impacts discussed in Chapters 4 and 5.

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater-drainage system affect both the recharge to the subsurface groundwater and the rate and location that precipitation drains into adjacent creeks and streams. Impervious areas reduce recharge to aquifers beneath the site. Pervious areas, for example, graveled laydown areas, managed to reduce runoff and maintained free of vegetation, would experience considerably higher recharge rates than adjacent vegetated areas. The stormwater-management system includes site grading, drainage ditches, swales, and retention and filtration ponds. This system provides both a safety function to keep locally intense precipitation from flooding safety-related structures, and an environmental function of managing site runoff to minimize erosion and impacts on nearby water resources. Three retention and infiltration ponds would be created on the LNP site (PEF 2009a). These ponds are shown in relation to major structures, parking lots, and laydown areas in Figure 3-4.

3.2.2.2 Cooling System

The cooling system and its principal components would represent one of the largest interfaces between proposed Units 1 and 2 and the environment. Makeup water would be provided to the

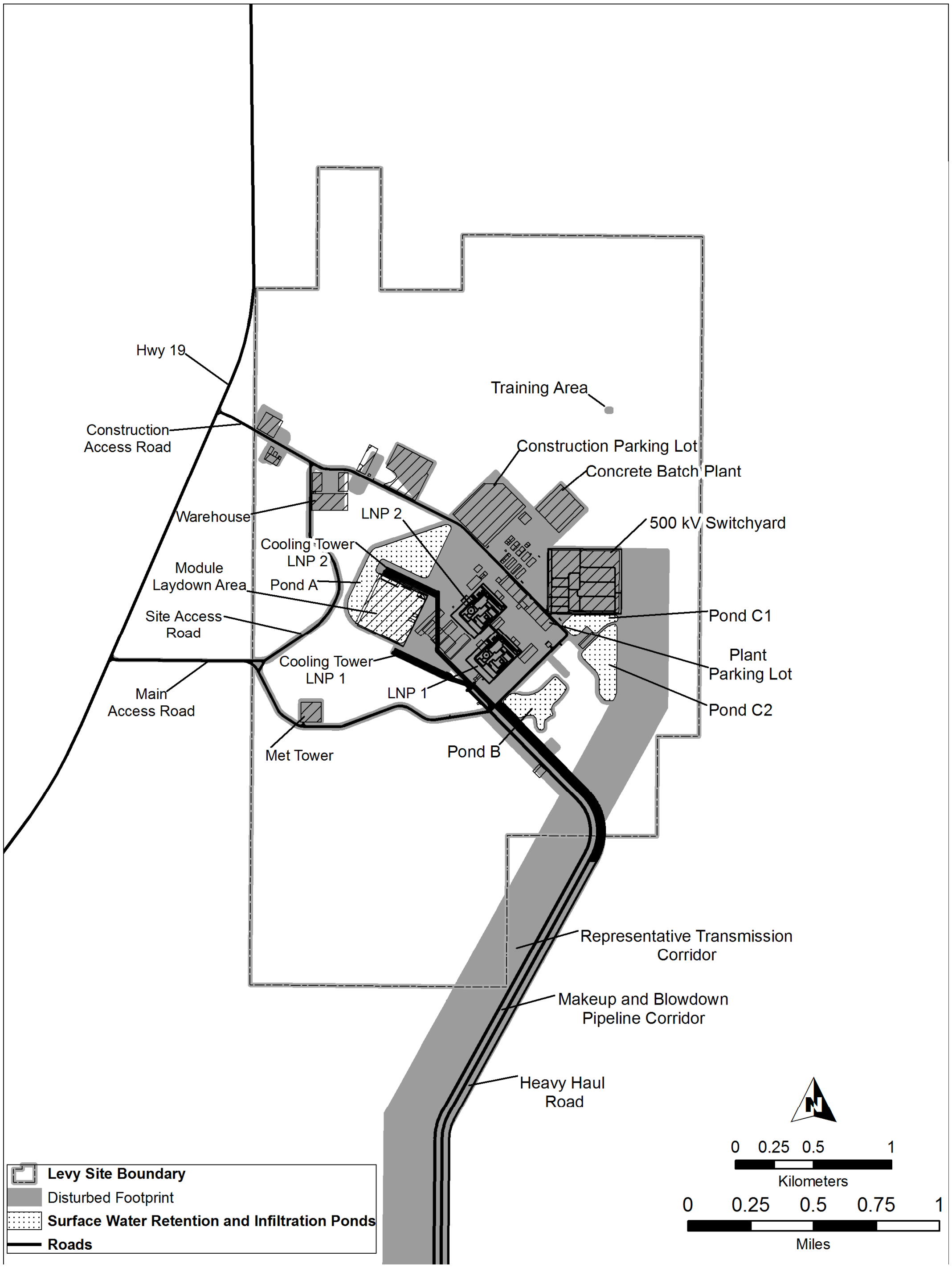

Figure 3-4. LNP Units 1 and 2 Detailed Site Layout (modified from PEF 2009a)

plant from the Cross Florida Barge Canal (CFBC) through a cooling-water-intake structure (CWIS) located on the north side of the canal and south of the LNP site. A portion of the makeup water would be returned to the environment via the discharge structure at the CREC site. The remaining portion of the water would be released into the atmosphere via evaporative cooling through mechanical draft cooling towers. The intake and discharge structures and mechanical draft cooling towers are components that have a major plant-environment interface. This section describes these components based on the information provided by PEF in its ER (PEF 2009a) and FSAR (PEF 2009b).

Cooling-Water Intake Structure

Proposed LNP Units 1 and 2 would obtain makeup water for the circulating-water system (CWS) from the CFBC. A CWIS would be constructed on the north bank of the canal approximately 0.5 mi west of Inglis Lock (Figure 3-1). The length of the water-facing side of the intake structure would be approximately 111 ft. The intake structure would extend approximately 86 ft inland from the water's edge (PEF 2009a). A structure containing the intake pumps and pipe manifold would extend approximately 25 ft farther inland (PEF 2009c). Figure 3-5 and Figure 3-6, respectively, show the approximate dimensions and location of the intake structure. The bottom of the intake structure would be approximately 10 ft below the water surface in the canal (PEF 2009d). The intake structure would house six raw-water pumps (three per AP1000 unit), each in an individual pump bay with vertical trash bars for coarse-debris removal and a traveling screen for fine-debris removal. The traveling screens would have mesh openings of 3/8 in. (PEF 2009a). The intake structure would also house pumps for washing the traveling screens, but PEF has not proposed a fish return system.

Discharge Structure

No new discharge structure is proposed for LNP Units 1 and 2. Cooling-water discharges from LNP Units 1 and 2 would be transported via pipeline from the LNP site to the CREC site (Figure 3-7). The LNP discharge would be combined with CREC discharges and released into the existing CREC discharge canal to be ultimately released into the Gulf of Mexico (PEF 2009d). Pipelines are described in Section 3.2.3.

Cooling Towers

The LNP Units 1 and 2 CWS would use mechanical draft cooling towers to dissipate waste heat from the plant. Each reactor unit would be served by a multicell cooling tower and each tower would be approximately 1000 ft long and approximately 56 ft high (PEF 2009a). Each CWS cooling tower would be located west of its respective unit (Figure 3-4). The service-water system would use a two-cell mechanical draft cooling tower with a divided basin (PEF 2009a) to cool the nonsafety-related component cooling-water system heat exchangers in the turbine building. The SWS cooling tower would be located adjacent to the turbine building.

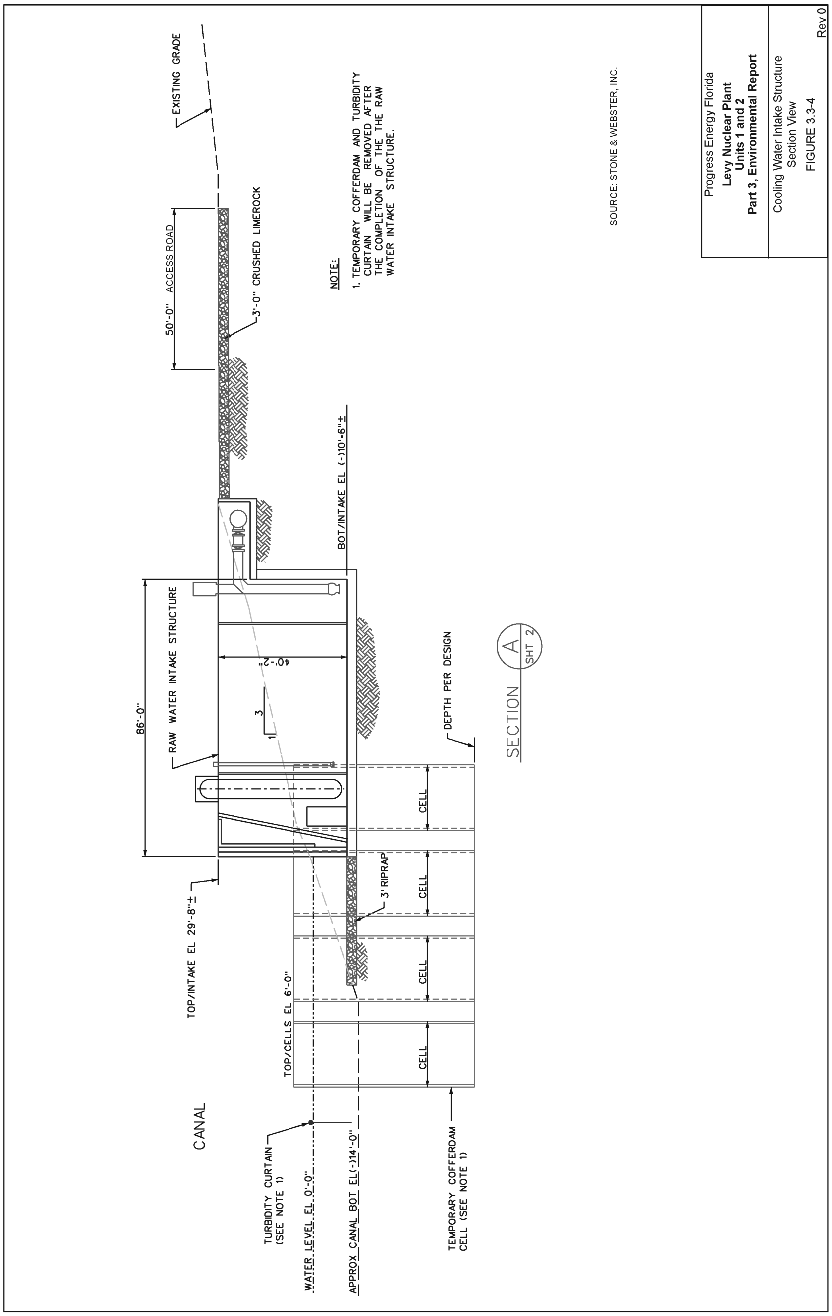

Figure 3-5. Section View of the Cooling-Water-Intake Structure (PEF 2009a)

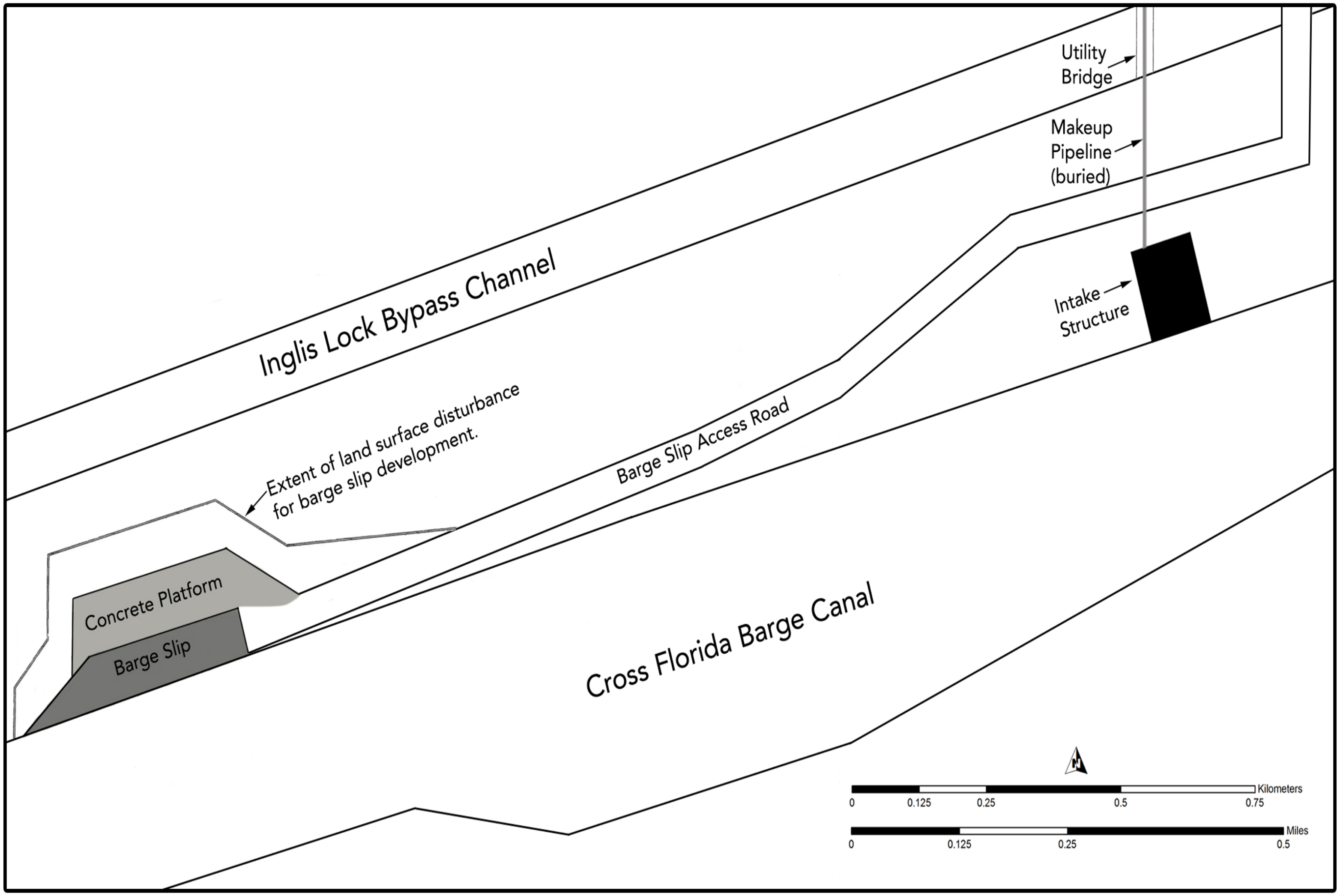

Figure 3-6. Proposed Cooling-Water-Intake Structure and Barge Unloading Facility Layout (PEF 2008c)

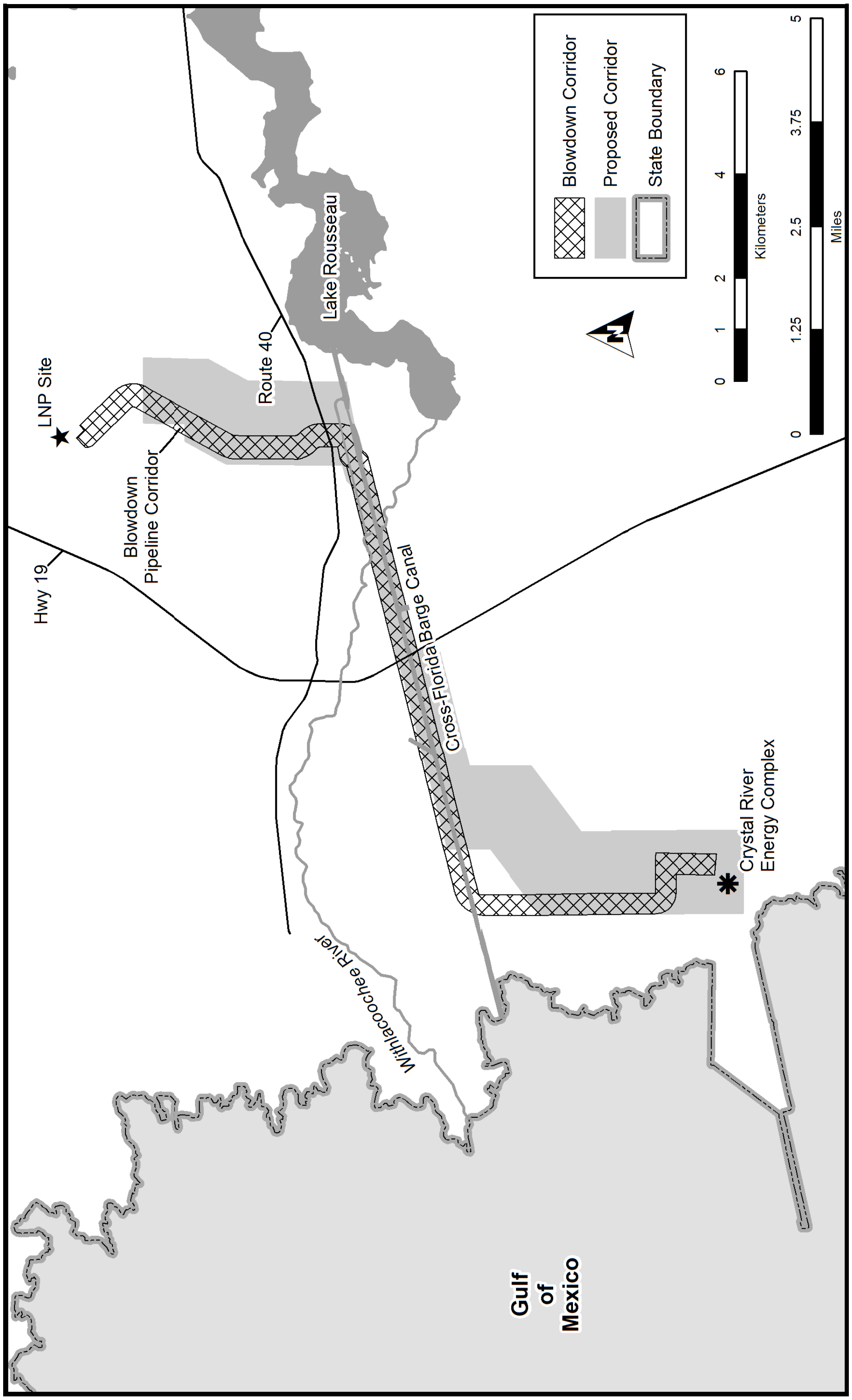

Figure 3-7. Discharge Pipeline Route and CREC Discharge Canal (PEF2009a)

3.2.2.3 Other Permanent Structures, Systems, or Components with an Environmental Interface

Buildings and roads are the additional permanent plant-environment interfacing structures that would be built on the LNP site.

Diesel-Generator Building

Diesel generators would be installed on the site to provide a backup source of power when the normal power source is disrupted. Combustion emissions would be released to the atmosphere from the generators only during emergency operations and periodic testing. Two standby diesel generators and two auxiliary diesel generators would be located in the diesel-generator building (PEF 2009a).

Roads

The workforce and some material would enter and exit the site via roads. Access to the LNP site would be provided by two access roads approaching the site from U.S. Highway 19 (US-19). Solid waste and radioactive waste are expected to leave the site via roadways. Large components and material shipments would be brought onsite via a new heavy-haul road that would enter the site from the south and connect to US-40. A barge slip access road would connect the barge slip to the heavy-haul road (Figure 3-1). The barge slip access road would also allow access to the intake structure. The heavy-haul road would be 3.3 mi long and the barge slip access road would be 0.6 mi long (PEF 2009a).

Diaphragm Wall and Grout Injection

Building LNP Units 1 and 2 would require excavation below the current water table elevation. Therefore, temporary dewatering would be necessary. The current conceptual foundation design calls for substantial dewatering of each nuclear island area to depths of approximately 100 ft below existing grade (PEF 2009b). Diaphragm walls would be installed below land surface surrounding the area to be excavated to minimize the lateral flow of groundwater into the excavation. Grout would also be injected into the carbonate rock below the planned excavation depth to minimize upward groundwater flow into the excavation.

Groundwater Wells

Groundwater wells would be installed to supply water for building activities and to supply water to the raw-water system. During plant operations, water would be withdrawn to supply makeup water to the service-water system, and provide raw water to the potable-water supply, the demineralized-water system, for fire protection, and for media filter backwash (PEF 2009b). Four groundwater wells would be located south of the LNP site and north of the CFBC (Figure 3-1).

Barge-Unloading Facility

Large components for the proposed reactors would be brought to the site on barges. A barge facility would be needed to allow components to be unloaded onto transporters and moved to the site. The barge-unloading facility would be located on the northern bank of the CFBC west of the CWIS (Figure 3-1) (PEF 2009a).

Radwaste Facility

Liquid, gaseous, and solid radioactive waste-management systems would collect the radioactive materials produced as byproducts of operating the proposed units. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits as described in Section 3.4.3.

Sanitary Waste-Treatment Plant

The proposed sanitary waste-treatment plant would consist of two package sewage-treatment plant units.

Power Transmission System

The LNP site is a greenfield site and not presently connected to the regional power grid (Section 2.2.2). Integrating the additional electrical output of the proposed units would require that several new transmission-line corridors be acquired and transmission lines be built. PEF is in the process of acquiring rights-of-way for transmission-line corridors that would provide the connection between the LNP site and the area power grid.

The LNP site would be connected into the PEF transmission system, which supplies large load centers in the Central Florida region, including Orlando and St. Petersburg (PEF 2009a). The two power-generating units would be tied into the PEF 500-kV transmission system via a 500-kV switchyard and four 500-kV transmission lines. These lines would connect the LNP site to the Citrus substation and the Central Florida South substation, with two 500-kV transmission lines connecting each. PEF is currently in the process of acquiring and planning rights-of-way for transmission-line corridors exiting the LNP site. The proposed corridor would fall within wider planning corridors ranging from 1000 to 2640 ft wide to allow for flexible planning. Figure 2-5 shows the proposed transmission-line corridors and substations. The addition of two 69-kV lines would also be required to support building and administrative operations. In total, about 180 mi of new transmission-line corridor would be needed to connect the LNP site to the electrical grid system (PEF 2008). Table 2-1 lists the affected land uses and linear runs of each potential corridor.

The operation of LNP Units 1 and 2 would require that two additional substations be added to the Florida electrical grid (PEF 2009a). The first, an expansion at the Citrus substation, would be approximately 70 ac in size and would be designed to support 500-kV and 230-kV transmission lines. It would be located in Citrus County near the existing Crystal River East substation. The second, the proposed Central Florida South substation, would be approximately 60 ac in size and support both 500-kV and 230-kV lines. It would be located due south of the existing Central Florida substation.

Four 230-kV transmission lines would also be needed beyond the Central Florida South and the Citrus substations (PEF 2009a). The first of these routes would be a transmission-line corridor accommodating two 230-kV lines that connect the Crystal River East substation to the proposed Citrus substation. Another 230-kV transmission line would originate at the CREC 500-kV switchyard and terminate at the existing Brookridge substation in Hernando County. The third line would begin at the Brookridge substation and run to the Brooksville West substation, both of which are in Hernando County. A fourth transmission line would be built from Polk to Hillsborough to Pinellas, originating at the Kathleen substation in Polk County, running south to the Griffin substation in Hillsborough County, and running west to terminate at the existing Lake Tarpon substation in Pinellas County. This transmission line would be collocated with the Kathleen-Griffin 230-kV line and the Higgins-Griffin 115-kV line, an existing transmission-line corridor.

3.2.2.4 Other Temporary Plant-Environment Interfacing Structures

Some temporary plant-environment interfacing structures would need to be removed before proposed Units 1 and 2 operation commences; for example, a concrete batch plant. The impacts from the operation and installation of these structures are discussed in Chapter 4.

Dewatering Systems

Dewatering systems (dewatering wells or sump pumps) are used to lower the water table in excavations that would otherwise be inundated by the influx of groundwater. Water within the structure created by the diaphragm walls and grouted limestone would then be removed by using shallow wells and sump pumps (PEF 2009b).

Cranes and Crane Footings

Crane footings would be fabricated and cranes would be erected on the site to build the plant.

Concrete Batch Plant

A concrete batch plant would be located onsite to supply concrete for structures (Figure 3-4). The facility would house the equipment needed for delivery, materials handling and storage, and preparation of concrete.

3.2.3 Structures with a Minor Environmental Interface

The structures described in the following sections would have minimal plant-environment interfaces during plant operation. The impacts of these structures on the environment were determined by the review team to be of such minor significance that the structures are not discussed in Chapter 5.

3.2.3.1 Nuclear Island, Turbine Building, and Annex Building

The AP1000 nuclear island consists of a containment building, shield building, and an auxiliary building. The foundation for the nuclear island is an integral basemat that supports these buildings. The nuclear island structures are designed to withstand the effects of natural phenomena such as hurricanes, floods, tornadoes, tsunamis, and earthquakes without loss of capability to perform safety functions (PEF 2009a). The turbine building houses the main turbine generator and associated systems. The annex building provides personnel and equipment support areas, and access to the nuclear island.

3.2.3.2 Pipelines

Water would be sent from the intake structure on the CFBC approximately 4 mi to the onsite cooling-tower basins through two 54-in.-diameter intake pipelines for each nuclear unit (four in total) (PEF 2009d). The intake pipeline corridor is shown in Figure 3-1 and in Figure 3-4.

Two additional 54-in.-diameter pipelines would carry discharged cooling water from both units approximately 13 mi to the CREC discharge canal (Figure 3-7). The pipelines would cross over the Inglis Lock bypass channel and under the CFBC (PEF 2009d). Additional pipelines would be required to move water from groundwater wells to operating facilities and between the cooling towers and the plant systems requiring cooling.

3.2.3.3 Miscellaneous Buildings

A variety of small buildings would exist throughout the site to support worker, fabrication, building, and operational needs (e.g., shop buildings, support offices, warehouses, and guard houses). Some buildings may be temporary and would be removed after the plant begins operation.

3.2.3.4 Parking

Parking areas would be created to support the construction workforce and some parking would be retained for the operating workforce once plant installation is completed (Figure 3-4).

3.2.3.5 Laydown Areas

Multiple laydown areas would be established to support fabrication and erection activities while building the plant and may be maintained as laydown areas for future maintenance and refurbishment of the plant (Figure 3-4). Laydown areas are graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas.

3.2.3.6 Switchyard

The location of the proposed switchyard is shown in Figure 3-4. The switchyard would be maintained free of vegetation.

3.3 Construction and Preconstruction Activities

The NRC's authority is limited to construction activities that have a "reasonable nexus to radiological health and safety or common defense and security" (72 FR 57416) and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction (defined at 10 CFR 50.10(a)) activities for safety-related structures, systems, or components include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing.

Other activities related to building the plant that do not require NRC approval (but may require a Department of Army permit from the USACE) may occur before, during, or after NRC-authorized construction activities. These activities are termed "preconstruction" in 10 CFR 51.45(c) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as site preparation (e.g., clearing, grading, erosion control, and other environmental mitigation measures); erection of fences; excavation; erection of support buildings or facilities; building service facilities (e.g., roads, parking lots, transmission lines, sanitary waste-treatment system, intake and discharge structures); dredging; and procurement or fabrication of components occurring at other than the final in-place location at the site. Activities not included in construction are identified in 10 CFR 51.10(a)(2). Additional information about the delineation of construction and preconstruction activities is presented in Chapter 4.

This section describes the structures and activities associated with building proposed Units 1 and 2. This section characterizes the major activities for the principal structures to provide the requisite background for the assessment of environmental impacts. However, it does not represent a discussion of every potential activity or a detailed engineering plan. Table 3-1 provides general definitions and examples of activities that would be performed when building the proposed units.

1 **Table 3-1**. Descriptions and Examples of Activities Associated with Building Units 1 and 2

Activity	Description	Examples
Clearing	Removing vegetation or existing structures from the land surface.	Cutting planted pines from an area to be used for construction laydown.
Grubbing	Removing roots and stumps by digging	Removing stumps and roots of pines logged from construction laydown area.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Leveling the site of the reactors and cooling towers.
Hauling	Transporting of material and workforce along established roadways.	Driving on construction access road by construction workers; transporting material from the barge slip to the site on the barge slip access road.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas and site drainage.	Paving a parking area.
Well drilling	Drilling and completion of wells.	Drilling water-supply wells.
Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Placing pipelines; setting foundations for small buildings.
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating to support fabrication of the basemat for the reactor.
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from excavation of base for reactor building.
Grouting	Installing low-permeability material in the subsurface around deep excavation to minimize movement of groundwater.	Installing a diaphragm wall around the excavation for the reactor building.
Dredging	Removing substrates and sediment in navigable waters including wetlands.	Creating the barge slip.
Filling of wetland or water body	Discharging dredge and/or fill material into waters of the United States including wetlands.	Placing fill material into a wetland to bring it to grade with adjacent land surface.
Dredge placement	Placing fill material in areas not designated as wetlands. These materials can come from dredging wetlands.	Placing sediments removed from the barge slip in a USACE-approved placement area.

Table 3-1. (contd)

Activity	Description	Examples
Spoils placement	Placing construction (earthwork) or dredged material in an upland location.	Placing sediment excavated from the intake area in upland disposal area.
Filling of aquatic resources	Discharge of dredge and/or fill material into waters of the United States, including wetlands.	Placing a culvert for a roadway.
Erection	Assembling all modules into their final positions including all connection between modules.	Using a crane to assemble reactor modules.
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing and pouring concrete; laying rebar for basemat.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining the switchyard free of vegetation.

Source: PEF 2009a

3.3.1 Major Activity Areas

PEF has stated that activities required to build the proposed units would occur primarily within the boundaries of the LNP site and at offsite locations along the CFBC (PEF 2009a), except for the new transmission lines and substations described in Sections 2.2.2 and 3.2.2.3. Access roads for Units 1 and 2 would enter the property from the northwest and the south (barge slip access road). The intake structure would be on the CFBC, south of Units 1 and 2. The following sections briefly describe the construction and preconstruction activities associated with the structures described in Sections 3.2.2 and 3.2.3.

3.3.1.1 Landscape and Stormwater Drainage

Preparation for building and operating the proposed LNP Units 1 and 2 would require land to be cleared and graded for the main reactor buildings and support facilities and additional space for material and equipment laydown areas. The elevation of the land surface in some areas of the site would be raised to meet the requirements of the AP1000 DCD (Westinghouse 2008). The details of the alterations are discussed in the following sections.

After the site is graded, a stormwater-drainage system would be created around the facilities to direct stormwater away from the operational areas. Drainage ditches and pipes would route surface water to three water-retention and/or infiltration ponds. The locations of these ponds are shown in Figure 3-4.

3.3.1.2 Circulating-Water Intake Structure

Building the intake structure would require excavation to more than 10 ft below the water level, and dredging of a portion of the CFBC. Figure 3-6 shows a proposed temporary cofferdam in place enclosing an area approximately twice as wide as the proposed intake structure and extending out into the CFBC. The cofferdam is surrounded by a turbidity curtain. Riprap will be installed on the canal bank upstream and downstream of the intake structure.

3.3.1.3 Circulating-Water Discharge Structure

No new building is expected for the discharge structure outside of the existing CREC discharge canal.

3.3.1.4 Diesel Generators

Building the diesel-generator facility would involve limited fabrication and erection.

3.3.1.5 Roads

Building of the heavy-haul road and the barge slip access road would require land to be cleared and graded along the proposed route shown in Figure 3-1 (PEF 2009a). Temporary and permanent access roads to support site building and operations activities would require land to be cleared and graded along the routes shown in Figure 3-4 (PEF 2009a).

3.3.1.6 Grouting and Dewatering

The grouting program would consist of vertical diaphragm walls around the proposed powerblock area to minimize lateral groundwater inflow and pressure grouting of the Avon Park Formation below the planned excavation depth. These two engineered barriers would form a "bathtub" that can then be dewatered and excavated.

Shallow excavation for foundations for other buildings and trenching for pipelines may also require dewatering.

Water from the excavations would be pumped to temporary ponds constructed to allow the water to percolate into the subsurface. PEF indicates that sedimentation traps or filtration would be included in the design of the dewatering system to ensure that negligible erosion or siltation occurs during the dewatering operation (PEF 2009a).

Dewatering wells would be drilled into the Upper Floridan aquifer using standard drilling practices.

3.3.1.7 Water-Supply Wells

PEF plans to construct four 16-in.-diameter water-supply wells south of the plant. The wells would be constructed to a maximum depth of 500 ft and cased to at least 150 ft. The pump capacity for each well would be 1000 gpm. Wells would be drilled using standard drilling practices (PEF 2009e).

The four onsite water-supply wells would be used to obtain water for site-preparation and building activities. During building, the total maximum usage is projected to be 550,000 gpd and the projected average estimated maximum groundwater usage is 275,000 gpd. These estimates include the following:

- 300,000 gpd for soil compaction
- 100,000 gpd for dust and erosion control
- 100,000 gpd for concrete mixing
- 50,000 gpd for other miscellaneous uses (PEF 2009a).

3.3.1.8 Barge Facility

Excavation for the barge slip would require dredging of 1.1 ac below mean high water and excavation of 1.0 ac above mean high water. PEF estimates that 83,044 yd^3 of material would be excavated to create the barge slip (PEF 2009a). Of this amount, 23,260 yd^3 would be dredged material.

Dredge spoil stockpile areas would be graded and compacted by traffic. The stockpile areas would be surrounded by silt fencing or vegetated buffer strips. Dredge spoils would be characterized and stockpiled for future use or properly disposed of according to regulatory requirements, if necessary. Spoil areas would have water sprayed on exposed soil to minimize wind erosion during dry periods. Vegetation would be grown on stockpiles to minimize erosion (PEF 2009a).

3.3.1.9 Sanitary Waste-Treatment Plant

Building the sanitary waste-treatment plant would involve limited fabrication and erection.

3.3.1.10 Power Transmission System

Building the transmission system would require the removal of trees and shrubs along portions of the transmission-line corridor and involve the erection and fabrication of switchyard and transmission lines (PEF 2009a).

Transmission structures would be built on various types of engineered foundations. These foundations would likely be either direct buried with a concrete backfill or reinforced concrete drilled piers. Guys and anchors at angle and corner structures would also be used to support the loads at corners. PEF estimates that it would require approximately 91 mi of transmission lines to connect the LNP site to the first substations. Standard structure heights would range from 110 to 195 ft, with span lengths of 1000 to 1500 ft between structures. Ground clearance for the transmission lines would be 35 ft at 284°F (conductor temperature). Phase spacing would be approximately 34 ft, with each structure typically carrying a single circuit line of three phases of triple-bundled, steel-reinforced aluminum conductors of 1590 thousand circular mils with two shield wires (PEF 2009a). Figures 9 A3.2-1 through 9 A3.2-14 in the Site Certification Application to the State of Florida provide representative arrangements of alternative tower designs within proposed corridors; Figures 9 A3.2-15 and 9 A3.2-16 provide illustrations of potential ground-disturbing activities, including the building of access roads and transmission tower footings (PEF 2008).

The 500-kV transmission lines and their support structures would be designed to handle a range of extreme weather conditions experienced in the area (PEF 2009a). PEF designed its transmission system to meet several load cases. These load cases include 2007 National Electric Safety Code (NESC) Light Load District standards for combined ice and wind load of 0-in. radial ice and 60-mph winds. In addition, the transmission system has been designed to meet the 2007 NESC Extreme Wind Loading of 130-mph winds, and PEF's High Wind Loading threshold of 145 mph (PEF 2009a).

3.3.1.11 Cranes and Crane Footings

Fabricating footings, building retaining walls, and erecting cranes would be necessary to build the larger plant structures.

3.3.1.12 Concrete Batch Plant

The temporary concrete batch plant would involve limited erection on a cleared, graded area.

3.3.1.13 Powerblock and Cooling Towers

The powerblock consist of the reactor building, the radioactive waste building, the turbine building, service buildings, and associated structures. Deep excavation and extensive fill placement and large-scale fabrication and erection activities would be involved in building the powerblock facilities. An onsite concrete batch plant would fabricate concrete for numerous pours. Various components would be hauled to the site via barge and road. Many of these structures would be erected using components delivered as large modules and installed via crane.

3.3.1.14 Pipelines

The pipelines connecting the intake structure to the cooling-tower basins would run north from the intake structure along the heavy-haul road. The blowdown lines would run south from the cooling-tower basins to the CFBC in the same corridor as the intake pipelines. The pipeline would run west on the north side of the Inglis Lock bypass channel and cross the bypass channel and CFBC just north of the CREC. The pipeline would then follow an existing transmission-line corridor into the CREC and to the existing CREC discharge canal as shown in Figure 3-7.

The intake and discharge pipelines would generally be buried to a minimum depth of 5 ft. Building the pipelines would require the clearing of land along the pipeline corridor and shallow excavation (trenching) to allow installation of the pipeline. The discharge pipelines would cross over the Inglis Lock bypass channel on a 33-ft-wide utility bridge. The pipelines would pass under the CFBC (PEF 2009d).

A trench would be excavated in the bottom of the canal to allow the pipeline to be placed below the existing canal bottom. The canal bottom contour would be restored once the pipeline is installed. No long-term changes to the channel configuration of the CFBC would occur and, once installation is completed, navigation through the canal should not be affected (PEF 2009a).

3.3.1.15 Miscellaneous Buildings

Shallow excavation for foundations would be required prior to fabrication and erection of miscellaneous buildings.

3.3.1.16 Parking

Parking areas would be graded and paved.

3.3.1.17 Laydown Areas

Laydown areas would be graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas. These laydown areas would affect approximately 120 ac (PEF 2009a).

3.3.1.18 Switchyard

Building the proposed 500-kV switchyard would require clearing and grading 48.2 ac of land (PEF 2009a). The switchyard and other areas around the main plant building would be graded and filled to raise the elevation of the land surface to 47 ft NAVD88 (PEF 2009a).

3.3.2 Summary of Resource Commitments Due to Building Activities

Table 3-2 lists the significant resource commitments for construction and preconstruction. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in the ER (PEF 2009a), and the review team determined that the values are not unreasonable.

Table 3-2. Summary of Resource Commitments Associated with Construction and Preconstruction of Proposed Units 1 and 2

Resource Area	Value	Description	Reference
All Resource Areas	60 months (5 years) per unit, 72 months (6 years) total	Duration of construction and preconstruction activities (18 months for preparation, 42 months for building per unit, expected to be staggered 1 yr between units)	(PEF 2009a)
Socioeconomics, Transportation, Air Quality	3300 workers	Peak workforce occurring in the third quarter of the third year of building	(PEF 2009a)
Land Use, Terrestrial Ecology, Historic and Cultural Resources (Site and Vicinity)	777 ac	Disturbed area footprint: 627 ac permanently disturbed; 150 ac temporarily disturbed	(PEF 2009f)
Land Use, Terrestrial Ecology, Historic and Cultural Resources	180 mi[a]	Length of new transmission-line corridors	(PEF 2008)
	1000 to 2640 ft	Width of new transmission-line corridors	
Hydrology – Groundwater	275,000 gpd	Average groundwater withdrawal rate	(PEF 2009a)
	550,000 gpd	Maximum groundwater withdrawal rate	
	75 ft[b]	Excavation depth to which dewatering would be required (below land surface at 50 ft NAVD88)	(PEF 2009a)
Hydrology – Surface Water, Aquatic Ecology, Terrestrial Ecology, Land Use	83,044 yd^3	Volume of material excavated or dredged to create the barge-unloading facility	(PEF 2009a)
	23,260 yd^3	Volume of dredged material requiring disposal	
Terrestrial Ecology, Socioeconomics, Nonradiological Health	104 dB	Peak noise level 50 ft from activity	(PEF 2009a)
	74 dB	Noise level 1500 ft from activity	

(a) Rounded from 83 mi of 500 kV corridor and 95 mi of 230 kV corridor (see Section 2.2.2)
(b) Dewatering depth is 100 ft

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment, as described in Section 3.2.2. Examples of operational activities are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by the applicant in the FSAR portion of its application (PEF 2009b). The results of NRC's safety review will be documented in its Safety Evaluation Report.

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), the radioactive and nonradioactive waste-management systems (Sections 3.4.3 and 3.4.4), and a summary of the resource commitments likely to be experienced during operations (Section 3.4.5).

3.4.1 Description of Operational Modes

The operational modes for proposed Units 1 and 2 considered in the assessment of operational impacts on the environment (Chapter 5) are normal operating conditions and emergency shutdown conditions. These are the nominal conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are alternate modes to normal plant operation during which water intake, cooling-tower evaporation, water discharge, and radioactive releases may change from nominal conditions.

3.4.2 Plant-Environment Interfaces During Operation

This section describes the operational activities related to structures with an interface to the environment.

3.4.2.1 Circulating-Water System – Intakes, Discharges, and Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. The proposed LNP Units 1 and 2 would use closed-cycle wet-cooling systems to transfer heat from their main condenser to the multicell mechanical draft cooling towers. During normal plant operation, the CWS for each unit would dissipate up to 7.628×10^9 Btu/hr of waste heat to the atmosphere and 1.23×10^8 Btu/hr of waste heat via liquid discharges (PEF 2009a).

Excess heat in the cooling water would be transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. In addition to evaporative losses, a small percentage of water would also be lost in the form of droplets (drift) from the cooling tower. The water that does not evaporate or drift from the tower would be routed back to the cooling-tower basin.

Evaporation of water from the cooling towers increases the concentration of dissolved solids in the cooling-water system. To limit the concentration of dissolved solids, a portion of the circulating water would be continuously removed and replaced with makeup water from the CFBC. The water that is removed is called blowdown water. The blowdown water from each cooling tower would travel through the blowdown pipeline to be discharged to the CREC discharge canal and the Gulf of Mexico. PEF plans to operate the cooling-water system cooling tower to maintain a total dissolved solids concentration in the blowdown water between 1.5 to 2 times the influent concentration (commonly referred to as cycles of concentration) (PEF 2009a).

Key elements of the cooling-water system are shown in the water-balance diagram for an AP1000 shown in Figure 3-8.

PEF provided the following bounding water fluxes for the combined cooling-water system for both units:

- The maximum makeup-water flow rate would be 84,780 gpm.
- The maximum consumptive water-use rate (evaporation and drift) would be 28,260 gpm.
- The maximum blowdown rate would be 61,065 gpm (PEF 2009e).

Intake Structure

The canal intake structure contains three pumps for each AP1000 unit. Two of these pumps would withdraw water from the CFBC whenever the cooling-water system requires makeup water (PEF 2009a). The third pump would be maintained in standby mode and would start if one of the operating pumps ceases to function or is shut down for maintenance. Water entering the intake structure would pass through vertical trash bars and traveling screens to remove debris before reaching the pumps. The traveling screens would have mesh openings of 3/8 in. (PEF 2009a). The discharge from these pumps would be strained by an automatic strainer before discharging to the cooling-tower basins. Strainers would be backwashed to remove debris and send it back to the CFBC.

Normal operations for two AP1000 units would require withdrawal of 84,780 gpm from the CFBC to supply makeup water to the cooling-tower basins (PEF 2009a). Because these units would normally run at 100-percent power, this would also be the maximum withdrawal rate needed for plant operations. Consistent with EPA Phase 1 regulations for intake design, PEF has stated that the proposed intake structure would have a design through-screen velocity of less than 0.5 fps (PEF 2009a).

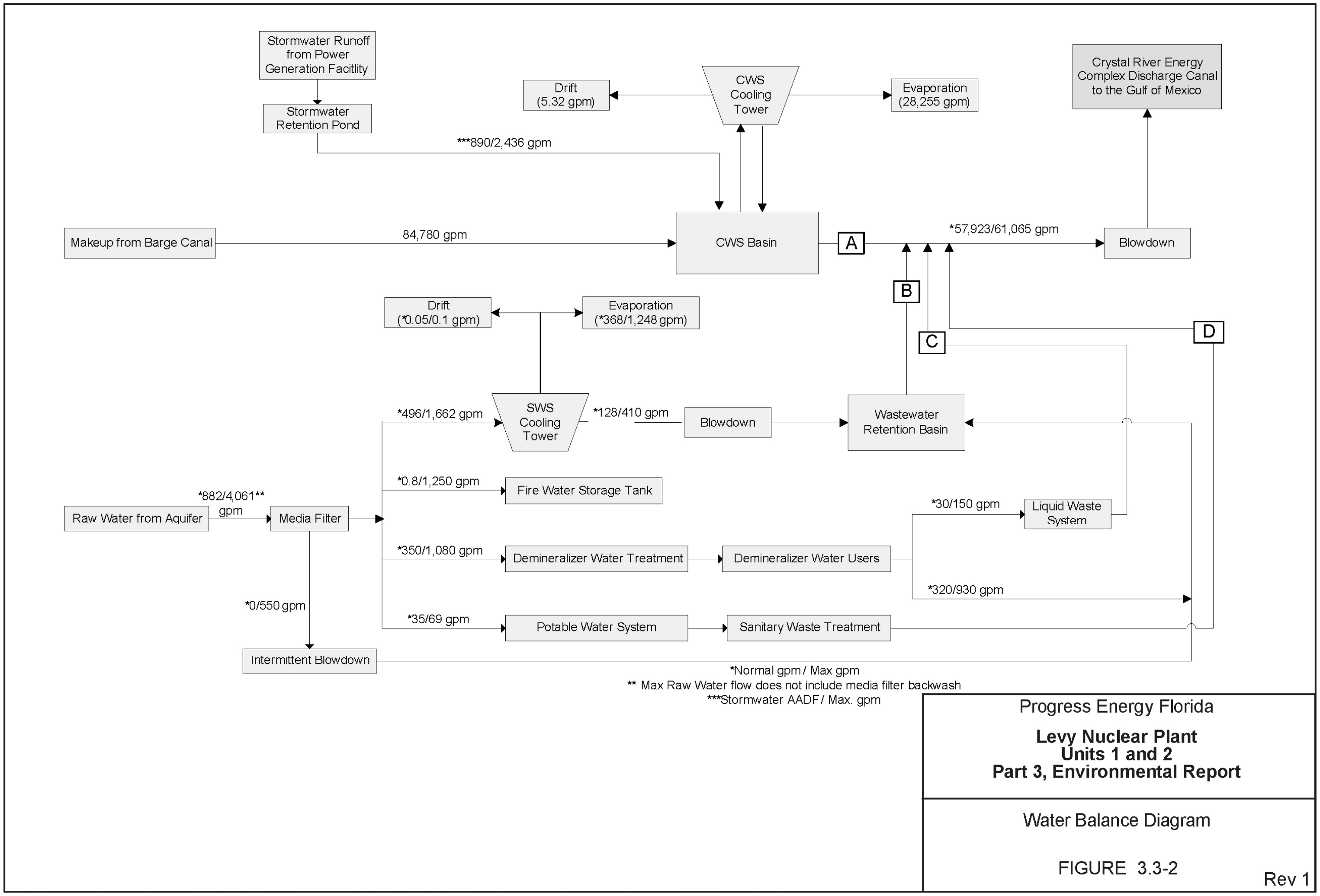

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Figure 3-8. LNP Units 1 and 2 Water-Balance Diagram (PEF 2009a)

Discharge Structure

Most of the maximum discharge to the CREC discussed above would come from the cooling-water system for the two units proposed for the LNP site. Normal operation of two AP1000 units would result in 57,923 gpm being discharged from the cooling system to the discharge line as blowdown water (PEF 2009a, e). Maximum discharge from the cooling system to the discharge line as blowdown would be 61,065 gpm. The difference between normal and maximum blowdown rates is primarily a result of intermittent discharge of stormwater to the cooling tower basins during periods when infiltration through the stormwater infiltration ponds is inadequate to dispose of stormwater runoff (PEF 2009a, e). All discharges would be sent to the CREC discharge canal, where they would be mixed with the discharges from the CREC and discharged to the Gulf of Mexico.

Cooling Tower

The cooling-water system cooling towers provide a mechanism for removing waste heat from the main condensers. Water would be circulated from the cooling-tower basin through the condensers by three pumps that would provide a flow rate of 177,000 gpm each. Because this flow does not interface directly with the environment, it is not shown on Figure 3.8. Once the water passes through the condensers it would return to the cooling towers where it would be cooled by evaporative and conductive cooling. Heat removed by these processes would pass to the atmosphere, and the cooled water would return to the cooling-tower basin. A portion of the water in the cooling-tower basins would be drawn off to eliminate contaminants that build up as a result of the evaporation process and would be discharged as blowdown. Less than two percent of the waste heat would be removed from the cooling system with the blowdown water. The blowdown temperature is expected to be 89.1°F at the cooling-tower design wet-bulb temperature of 83°F (PEF 2009a).

3.4.2.2 Service-Water System

The service-water system would supply cooling water to remove heat from the nonsafety-related component cooling-water system heat exchangers in the turbine building (PEF 2009a). Cooling for the service-water system would occur through a closed-cycle system using heat exchangers and a two-cell mechanical draft cooling tower with a divided basin. The basins would be supplied with makeup water from the raw-water system, which draws the makeup water from groundwater wells.

Within the service-water system tower, excess heat in the cooling water would be transferred to the atmosphere via evaporative and conductive cooling. The evaporation process increases the concentration of dissolved solids in the cooling water. To limit the concentration of dissolved solids, a portion of the water would be continuously discharged from the system as blowdown water, which would be routed to the cooling-water system retention basins. PEF provided the following bounding water flows for the service-water system for both units:

- The maximum makeup-water flow rate would be 1662 gpm.
- The maximum consumptive water-use rate (evaporation and drift) would be 1248 gpm.
- The maximum blowdown rate would be 410 gpm (PEF 2009e).

3.4.2.3 Water-Treatment Systems

Water taken into the various systems at the proposed LNP would require treatment to meet the requirements of the end use. Water-treatment systems would be in place for

- circulating water
- service water
- potable water
- demineralized water.

Water chemistry for the circulating-water system would be maintained by the turbine island chemical-feed system. This system would inject chemicals into the circulating water downstream of the circulating-water system pumps to maintain a noncorrosive, nonscale-forming condition and limit the formation of biological film within the system that could reduce the heat-transfer rate in the condenser and the heat exchangers of the circulating-water system (PEF 2009a). The chemicals used are generally classified as biocides, algaecides, pH adjusters, corrosion inhibitors, scale inhibitors, and silt dispersants. The pH adjuster, corrosion inhibitor, scale inhibitor, and dispersant chemicals would be metered into the system continuously or as required to maintain proper concentrations. The biocide application frequency would vary with seasons. The algaecide would be applied, as necessary, to control algae formation on the cooling tower. The chemicals used in the circulating-water system and the concentrations in the blowdown water are discussed in Section 3.4.4.2 under nonradioactive waste streams.

The service-water system chemistry would be controlled by the turbine island chemical-feed system. The system would inject chemicals into service-water pump discharge piping located in the turbine building to maintain a noncorrosive, nonscale-forming condition and limit the formation of biological film. Here again, the chemicals used are generally classified as biocides, algaecides, pH adjustors, corrosion inhibitors, scale inhibitors, and silt dispersants. The pH adjustor, corrosion inhibitor, scale inhibitor, and dispersant chemicals would be metered into the system continuously or as required to maintain the proper concentrations. Sodium hypochlorite would be used as the biocide and would control the microorganisms that cause fouling. The biocide application frequency would vary with seasons. Algae formation on the cooling tower would be controlled by application of an algaecide when necessary. The chemicals that could be used and their concentrations in the service-water system are discussed in more detail in Section 3.4.4.2 under nonradioactive waste streams (PEF 2009a).

The potable-water system would be designed to furnish water for domestic use and human consumption. It would be treated to comply with the following standards:

- bacteriological and chemical quality requirements as referenced in the "National Primary Drinking Water Standards," 40 CFR Part 141
- the distribution of water by the system in compliance with 29 CFR Part 1910, Occupational Safety and Health Standards.

The demineralized water-treatment system takes water from the raw-water system and processes it to remove ionic impurities. The station is expected to use reverse osmosis to demineralize water (PEF 2009a).

3.4.2.4 Landscape and Drainage

The landscape and drainage would determine the path that precipitation takes on the land surface. In addition, the land cover, soil moisture content, and soil type would determine the rate of recharge to the subsurface. The three ponds to be constructed for stormwater retention and infiltration are designed to drain through groundwater infiltration within 5 days. Any excess stormwater runoff that is sent to the ponds would be pumped to the cooling-tower blowdown basin and, if necessary, discharged with blowdown. The ponds are designed to retain a 25-year, 24-hour rainfall event. Larger storm events (100-year rainfall) would be drained out of the ponds through broad-crested weir emergency spillways provided in each of the ponds. Excess water from these maximum rainfall events would move from the spillways through long spreader swales to send runoff to the surrounding wetland as sheet flow to prevent erosion. The ponds would be constructed to maintain a minimum freeboard of 2 ft above the spillway elevation (PEF 2009a).

3.4.2.5 Water-Supply Wells

The four onsite water-supply wells would be used to supply general plant operations including makeup water for the service-water system, potable-water supply, raw water to the demineralizer, fire protection, and media filter backwash (PEF 2009a). PEF has estimated that plant operations would require an annual average total withdrawal of 1.58 Mgd of groundwater, and a potential maximum daily withdrawal of 5.8 Mgd (PEF 2009d).

3.4.2.6 Diesel Generators

Diesel generators would be installed on the site to provide a backup source of power to selected nonsafety electrical loads. Two 4000-kW standby diesel generators and two 35-kW auxiliary generators would be installed to support each unit at the LNP site (PEF 2009a). Emissions from these generators include particulates, sulfur oxides, carbon monoxide, hydrocarbons, nitrogen oxides, and carbon dioxide (PEF 2009a). Combustion emissions from the generators would be released to the atmosphere only during emergency operations and periodic testing. The diesel generators would be located in a diesel-generator building (PEF 2009a).

3.4.2.7 Transmission-Line Maintenance

Maintenance performed on the transmission lines for proposed LNP Units 1 and 2 would include a combination of aerial reconnaissance with helicopters and ground crews with trucks to conduct inspections of the corridors. The four 500-kV power transmission lines would pass through several types of undeveloped lands, ranging from upland areas to wetlands. Corridors passing through agricultural lands typically create only minimal disturbances because the land in the corridor can often remain productive. When corridors pass through wetland areas, restricted clearing and maintenance techniques would be used to reduce the total area of land disturbed. Annual inspection and maintenance activities within the corridors would be primarily preventive measures by mechanical, chemical, and manual methods. This includes clearing vegetative growth and removing dead trees along the edges of the corridor (PEF 2009a).

In its Site Certification Application (PEF 2008), PEF summarized other maintenance activities, including the following:

- mowing, pruning, and herbicide treatments
- encouraging the growth of low-growing woody and herbaceous vegetation that will not exceed 12 ft in height at maturity
- taking care not to cause unnecessary damage to vegetation in environmentally sensitive areas
- during line maintenance, alternatively girdling or selectively treating with herbicides any vegetation that may be cut during clearing of the corridor
- allowing girdled or treated vegetation to remain standing to provide habitat and food sources for wildlife
- basing the exact manner in which maintenance would be performed on the location, type of terrain, and surrounding environment
- addressing each area of a corridor based on site-specific vegetation and habitat
- working with public land managers to develop a management plan for the corridor where the 500-kV transmission-line corridor from the proposed LNP site to the proposed Central Florida South substation crosses public land.

To perform transmission-line maintenance, PEF uses various types of equipment, including helicopters, bucket trucks, cranes, semi-trucks, and support vehicles. Typical line-maintenance operations may include insulator replacements, conductor repairs, shield wire repairs, grounding, and other activities associated with structures, conductors, and foundations. Once onsite, the PEF crews would establish a safe working area and perform the required repair. Maintenance in environmentally sensitive areas, where access and fill pads do not exist, may require temporary matting to minimize damage to these areas during repairs (PEF 2008).

3.4.3 Radioactive Waste-Management Systems

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as byproducts of operating proposed LNP Units 1 and 2. These systems would process radioactive liquid and gaseous effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable (ALARA) before releasing them to the environment. Waste-processing systems would be designed to meet the design objectives of 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"). Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in the AP1000 reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities could escape the fuel rods into the reactor coolant. Neutron activation of the primary coolant system would also add radionuclides to the coolant.

Prior to fuel load, PEF would develop an Offsite Dose Calculation Manual (ODCM) describing the methods and parameters used for calculating offsite radiological doses from liquid and gaseous effluents. The ODCM would also describe the methodology for calculating gaseous and liquid monitoring alarm/trip set points for release of effluents from LNP, and would specify the operational limits for releasing liquid and gaseous effluents to ensure compliance with NRC regulations.

The systems used to process liquid, gaseous, and solid wastes are described in the following sections. A more detailed description of these systems for the proposed LNP Units can be found in Chapter 11 of the AP1000 Design Control Document (Westinghouse 2008). Solid radioactive wastes produced from operating LNP Units 1 and 2 would be both dry and wet solids.

3.4.3.1 Liquid Radioactive Waste-Management

The liquid radioactive waste-management system is designed to control, collect, segregate, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation and anticipated operational occurrences, including refueling operations. The liquid radioactive waste-management system is managed using several process trains consisting of tanks, pumps, ion exchangers, filters, and radiation monitors. Normal operations include processing of (1) reactor coolant system wastes, (2) floor drains and other wastes with potentially high suspended solid contents, (3) detergent wastes, and (4) chemical wastes. The discharge would be monitored and administratively controlled to confirm that it meets requirements of 10 CFR Part 20, Appendix B, Table 2 (Westinghouse 2008).

The liquid radioactive waste-management system would process and dispose of liquids containing radioactive material from the steam generator blowdown-processing system (DCD Section 10.4.8); radioactive waste drain system (DCD Section 9.3.5); and liquid radioactive waste system (DCD Section 11.2) (Westinghouse 2008). The liquid waste would be discharged from the monitor tank in a batch operation, and the discharge flow rate would be restricted as necessary to maintain an acceptable concentration when diluted by the circulating-water discharge flow. These features and procedures are designed to preclude uncontrolled releases of radioactive material (PEF 2009a). Discharges from the proposed LNP would be transported in two blowdown pipelines (one for each unit) from the LNP to the CREC discharge canal and into the Gulf of Mexico. Calculated dose to the maximally exposed individual (MEI) from gaseous effluents is evaluated in Section 5.9.1.

3.4.3.2 Gaseous Radioactive Waste-Management

The gaseous radioactive waste-management system functions to collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. The system is a once-through, ambient-temperature, activated-carbon delay system (Westinghouse 2008). Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel rods during operation. Some of these gases escape to the reactor coolant system through cladding defects. Some of these gases are released to the environment through the gaseous radioactive waste-management system or plant ventilation. In addition, various gaseous activation products, such as argon-41, are formed directly in the reactor containment during operation. The gaseous radioactive waste-management system is typically active only when monitored gaseous concentrations reach a given threshold. Waste gas flows through a guard bed that removes iodine, oxidizing chemicals, and moisture. From the guard bed it flows through two delay beds containing activated carbon, which dynamically adsorbs and desorbs the gases, delaying them long enough for significant radioactive decay to occur. The gaseous system can only delay noble gases, not collect them. If noble gases monitored in the coolant reach a threshold value, then the reactor coolant is diverted to the liquid radioactive waste-management system where the noble gases can be collected using the degasifier.

Radioactive gaseous effluents from the system described above are discharged through the plant vent, which is on the side of the containment building about 183 ft above grade level (Westinghouse 2008). Releases of radioactive gaseous effluents would also occur due to venting of the containment, auxiliary building, turbine building, condenser air removal system, and gaseous radioactive waste system discharges. These releases would be ongoing and there would be no holdup in the gaseous waste-management system and no batching of releases, as would be the case for the liquid effluents. At the proposed LNP, PEF would control and monitor releases of gaseous effluents from the plant so that the regulatory limits specified in 10 CFR Part 20 and 10 CFR Part 50, Appendix I, would not be exceeded (see PEF's ER Section 3.5.2, Tables 3.5-4 and 3.5-5) (PEF 2009a). Calculated dose to the MEI from gaseous effluents is evaluated in Section 5.9.1.

3.4.3.3 Solid Radioactive Waste-Management

The solid radioactive waste-management system functions to treat, temporarily store, package, and dispose of dry or wet solids. Solid radioactive wastes include spent ion-exchange resins, deep-bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes. The system has a 60-year design objective and is designed to handle both normal and anticipated operational occurrences. The packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility. The AP1000 solid radioactive waste-management system releases no gaseous or liquid effluent directly to the environment. This system discharges effluent through the liquid and gaseous waste-management systems.

The maximum total volume of shipped (wet and dry) solid radioactive waste would be 11,434 ft^3/yr from LNP Units 1 and 2 (PEF 2009a) with an expected total activity of radioactive material shipped from both units of 3.52×10^3 Ci/yr (PEF 2009a).

3.4.4 Nonradioactive Waste-Management Systems

The following sections describe the nonradioactive waste-management systems proposed for the LNP site, including systems for solid waste, liquid waste, gaseous waste, hazardous waste, and mixed waste.

3.4.4.1 Solid-Waste Management

The expected nonradioactive solid-waste streams during operational activities include water-treatment wastes, laboratory wastes, trash, effluents from the sanitary sewage-treatment system, and CWIS debris.

Solid waste generated during operation would be segregated and recycled to the extent practicable, with the balance disposed of in an offsite permitted landfill (PEF 2009a). PEF would institute a waste-minimization program during operation to promote pollution prevention, recycling, and reuse. Typical solid nonradioactive and nonhazardous waste generated during operation may include office paper, aluminum cans, laboratory waste, glass, and metals. Waste materials would be collected from several onsite locations and deposited in dumpsters located throughout the site. Recyclable materials would be collected and recycled by a commercial recycler. The remaining solid wastes would be collected by a licensed waste hauler and disposed of in a municipal landfill. None of these solid wastes would be burned or disposed of onsite. PEF estimates that during operation, the LNP would generate an average of 1617 tons of solid waste annually (PEF 2008).

The intake structure along the CFBC would have trash racks, traveling screens, and self-cleaning strainers. Debris collected from the trash racks and screens would be disposed of in local landfills. Water used to wash the screens or to backwash the strainers would be taken from and returned to the canal (PEF 2009a).

Aquifer well water for the raw-water system would pass through a self-cleaning strainer and a media filter to remove particulates. Water used to backwash the strainer and media filter would be directed to the settling basin and subsequently discharged to the cooling-water system blowdown pipe leading to the CREC discharge canal (PEF 2009a).

The reverse osmosis filters in the reverse osmosis system for demineralized water-treatment would need to be replaced periodically. The spent filters would be disposed of in accordance with applicable industrial solid waste regulations (PEF 2009a).

3.4.4.2 Liquid-Waste Management

The expected nonradioactive liquid waste streams include cooling-water blowdown, auxiliary-boiler blowdown, water-treatment wastes, discharge from floor and equipment drains, effluents from the sanitary sewage-treatment system, and stormwater runoff.

The AP1000 plant design consolidates most of the nonradioactive liquid effluent streams into a single combined discharge. All of these effluent streams would combine into a single stream and discharge via the CREC discharge canal into the Gulf of Mexico (PEF 2009a).

Chemicals that would likely be added to the plant cooling-water system, service-water system, demineralized water-treatment system, and blowdown system water streams include a biocide (sodium hypochlorite), an algaecide (N-alkyl dimethyl benzyl ammonium chloride or similar quaternary amine, pH adjusters (sulfuric acid, ammonium hydroxide), a corrosion inhibitor (ortho-polyphosphate), a silt dispersant (polyacrylate), an antiscalant (phosphonate), a coagulant (polyaluminum chloride), and an oxygen scavenger (hydrazine). Chemicals used to treat the cooling water would be mostly consumed or broken down prior to discharge (PEF 2009a).

Stormwater runoff from paved areas, roof drains, and the main plant area would flow over land to drainage channels leading to stormwater-retention ponds where the collected stormwater would percolate into the soil. Fire and supply test water would also be directed to the ponds.

Any excess stormwater from large precipitation events would be pumped from the ponds to the cooling-tower blowdown basin. Combined discharge from the CREC discharge canal outfall structure would be monitored for flow, pH, color, odor, clarity, floating solids, total suspended solids, foam, oil and grease, and other obvious indicators of stormwater pollution.

In accordance with Florida law (Fla. Admin. Code 62-620), any discharges during operation would need to comply with all applicable provisions of National Pollutant Discharge Elimination System (NPDES) Permit No. FL0633275-001-IW1S/NP (FDEP 2010a) upon final issuance, as well as any subsequent modifications, amendments, and/or renewals. It is anticipated that the permitted discharge concentrations for the proposed LNP would be similar to those specified in the CREC's NPDES Permit No. FL0000159 (FDEP 2010b). The expected levels of chemicals in the discharge are summarized in Table 3-3 (PEF 2008).

Table 3-3. Characterization of Potential Pollutants in the LNP Discharge to the CREC Discharge Canal

System	Chemical Type	Treatment	Expected Levels in Discharge
CWS	Biocide/sodium hypochlorite	Dechlorination prior to discharge	≤ 0.01 mg/L (negligible)
CWS	Algaecide/quaternary amine (methyl benzyl ammonium chloride or dimethyl benzyl ammonium chloride)	Dechlorination prior to discharge	≤ 0.01 mg/L (negligible)
CWS	pH adjustment/sulfuric acid	None	pH in range
CWS	Corrosion inhibitor/orthopolyphosphate	None	Small amount of total phosphorus (TP)
CWS	Silt dispersant/polyacrylate	None	Flocculant, inert solids <10 μm
SWS	Biocide/sodium hypochlorite	Wastewater retention basin, dechlorination prior to discharge	≤ 0.01 mg/L (negligible)
SWS	Algaecide/quaternary amine (ammonium chloride)	Wastewater retention basin, dechlorination prior to discharge	≤ 0.01 mg/L (negligible)
SWS	pH adjustment/sulfuric acid	Wastewater retention basin	pH in range
SWS	Corrosion inhibitor/ortho-polyphosphate	Wastewater retention basin	Small amount of TP
SWS	Silt dispersant/polyacrylate	Wastewater retention basin	Flocculant, inert solids <10 μm
SWS	Antiscalant/phosphonate	Wastewater retention basin	None due to infrequent use and small discharge volume.
DTS	pH adjustment/sulfuric acid	Wastewater retention basin	pH in range
DTS	Coagulant/polyaluminum chloride	Offsite disposal of solids	Inert particles <10 μm

Table 3-3. (contd)

System	Chemical Type	Treatment	Expected Levels in Discharge
DTS	Antiscalant/polyacrylate	Wastewater Retention Basin	Flocculant, inert solids <10 μm
WWS	Carbonaceous biochemical oxygen demand, 5-day	Activated sludge	<20 mg/L annual avg.; <30 mg/L monthly avg.; <60 mg/L daily maximum
WWS	Total suspended solids	Activated sludge	<30 mg/L avg. daily over 30 days; <100 mg/L daily maximum
WWS	Nutrients	Activated sludge	Typical domestic wastewater levels: nitrogen 10 to 20 mg/L; phosphorus 5 to 10 mg/L
WWS	Sludge	Activated sludge	Contract removal of solids
Storm	Total suspended solids	Settling in wet ponds	Will meet State treatment criteria prior to reuse in CWS. Typical range of runoff quality is 10 to 30 mg/L post-treatment.
Storm	Carbonaceous biochemical oxygen demand, 5-day	Settling in wet ponds	Will meet State treatment criteria prior to reuse in CWS. Typical range of runoff quality is 2 to 10 mg/L post-treatment.
Storm	Nutrients	Settling in wet ponds	Will meet State treatment criteria prior to reuse in CWS. Typical ranges of runoff quality are total nitrogen (TN) 1 to 2 mg/L and TP 0.1 to 0.3 mg/L post-treatment.
BDS	Oxygen scavenging/ hydrazine	Secondary treatment	Reduces to ammonia, reduced further by WWS. Negligible addition to WWS and infrequent.
BDS	pH adjustment/ammonium hydroxide	Secondary treatment	Reduces to ammonia, reduced further by WWS. Negligible addition to WWS and infrequent.

Source: PEF 2008
Storm = stormwater runoff from the power-generation area

The operational discharge from proposed LNP Units 1 and 2 would be combined with the current CREC discharge in the CREC discharge canal and would equal approximately 4.9 percent of the combined discharge. The cooling-water system would use closed-cycle cooling, with a chemical concentration factor between 1.5 and 2.0 (PEF 2009a). Therefore, due primarily to evaporative losses, the concentration of any naturally occurring dissolved solids in the intake seawater would be between 50 and 100 percent higher in the discharge water. Suspended solids, with the exception of material captured on the intake screens or self-cleaning strainers, would pass through the cooling-water system cooling tower or cooling-water system basin and be discharged to the CREC discharge canal. The concentration of suspended solids would be higher in the discharge water than in the intake seawater. Although the service-water system has a concentration factor between 2 and 4, it would not contribute to a significant increase in the average concentration of natural materials because the service-water system would use filtered groundwater and would contribute less than 1 percent of the combined cooling-water system and service-water system discharge flow. Some temporal variation would occur due to intermittent backwash and blowdown operations.

During LNP operation, one of the two sewage-treatment plants would support up to 800 people per day (40,000 gpd capacity) using the extended aeration process (PEF 2009a). In the extended aeration process, activated sludge is added to the wastewater influent, which is then held in an aeration tank for an extended time. This process produces a minimal amount of sludge, which would be removed as needed and disposed of by a licensed sanitation contractor (PEF 2008).

Sanitary wastewater would be treated to the levels indicated in Table 3-3 before being combined with the CWS blowdown for discharge to the CREC discharge canal. During operation, the expected maximum flow rate from the sanitary wastewater-treatment system of 69 gpm represents about 0.1 percent of the total LNP discharge. In the LNP NPDES application, Florida Wastewater Application Form 2CS, PEF indicates that fecal coliform would be absent from the combined LNP discharge (PEF 2008).

3.4.4.3 Gaseous-Waste Management

Gaseous emissions would be produced by the combustion of diesel fuel in the diesel engines that would power the two 2000-gpm fire pumps, the four 4000-kW standby generators, and the four 35-kW auxiliary generators. Based on four operating hours per month for each engine, the estimated annual emissions from these 10 engines are 2337 lb of particulates, 119 lb of sulfur oxides, 7161 lb of carbon monoxide, 2713 lb of hydrocarbons, 33,243 lb of nitrous oxides, and 1,236,250 lb of carbon dioxide (PEF 2009a). These emissions would be subject to the requirements of the Prevention of Significant Deterioration Permit, when issued.

Each of these diesel engines would have an associated fuel tank. The four tanks for the 4000-kW generators would each hold 85,000 gallons, the four tanks for the 35-kW generators would each hold 650 gallons, and the two tanks for the fire pumps would each hold 240 gallons. Total estimated hydrocarbon emissions from these tanks is 72 lb/yr due to volatilization of the diesel fuel (PEF 2009a). PEF also plans to construct and operate a fueling station in the motor pool area, but details are not yet available (PEF 2009c).

Small amounts of volatile organic compounds (VOCs) would also be generated from the use of common building maintenance materials such as paints, adhesives, and caulk; from mechanical maintenance materials such as oils and solvents; and periodically from activities such as asphalt resealing. Many of these materials are increasingly available in water-based or low VOC formulations, minimizing the magnitude of future VOC emissions.

3.4.4.4 Hazardous- and Mixed-Waste Management

The LNP is expected to be classified as either a conditionally exempt small-quantity generator or as a small-quantity generator of hazardous waste under the Resource Conservation and Recovery Act of 1976, as amended (RCRA). Hazardous waste generated during building activities could include small quantities of paints, solvents, greases, oils, caulk, and other common construction materials. No asbestos waste would be generated. During operation, only normal cleaning products, petrochemical products, water-treatment chemicals, and small quantities of additional regulated substances, such as laboratory chemicals, would be used onsite. Petroleum wastes could include waste gasoline, diesel fuel, oils, and grease.

All transportation, storage, and disposal of regulated hazardous wastes would be in accordance with applicable RCRA regulations. All hazardous wastes would be collected, transported offsite by a licensed and permitted RCRA waste hauler, and treated or disposed of offsite at a RCRA-permitted facility. Storage of some hazardous materials and associated wastes would occur in the Hazardous Waste Storage Building (Building 136), two Chemical Storage Buildings (Buildings 119 and 120), and the Painting and Sandblast Shop (Building 105) (PEF 2009a, c).

Mixed wastes contain both hazardous and low-level radioactive waste. Small amounts of mixed solid waste could be generated during maintenance, refueling, and laboratory activities. The AP1000 design includes a solid-waste-management system that is designed to collect and store mixed wastes generated during normal plant operation. The packaged waste would be stored in the auxiliary and radwaste buildings until it is shipped offsite to a licensed disposal facility.

PEF expects the LNP to generate about 0.3 m^3/yr of mixed waste with a maximum of 0.6 m^3/yr. The mixed waste from the LNP would be handled and managed in accordance with the applicable Federal and State regulations (PEF 2009a).

3.4.5 Summary of Resource Commitments During Operation

Table 3-4 lists the significant resource commitments involved in operating Units 1 and 2. The values in this table, combined with the affected environment described in Chapter 2, provide a part of the basis for the operational impacts assessed in Chapter 5. These values were stated in the ER (PEF 2009a) and supplemental RAI responses (PEF 2009d), and the review team has determined that the values are not unreasonable.

Table 3-4. Summary of Resource Commitments Associated with Operation of Proposed LNP Units 1 and 2

Resource(s)	Value	Parameter Description
Hydrology – Groundwater	1097 gpm (1.58 Mgd)	Annual average groundwater withdrawal rate
	4061 gpm (5.8 Mgd)	Maximum groundwater withdrawal rate
Hydrology – Surface Water	84,780 gpm (190 cfs, 122 Mgd)	Maximum CWS makeup-water flow rate (two units)

Table 3-4 (contd)

Resource(s)	Value	Parameter Description
Hydrology – Surface Water, Terrestrial Ecology, Meteorology-Air Quality	28,260 gpm (40.7 Mgd)	CWS consumptive use (evaporation plus drift, two units)
	28,255 gpm (40.7 Mgd)	CWS evaporation rate (two units)
	5.32 gpm	CWS drift rate (two units)
Hydrology – Surface Water	1.23×10^9 Btu/hr	Waste heat from CWS via liquid discharges
Hydrology – Surface Water, Aquatic Ecology, Nonradiological Waste Systems	57,923 gpm	Average CWS blowdown flow rate (two units)
	61,065 gpm	Maximum CWS blowdown flow rate (two units plus stormwater runoff)
	89.1ºF	CWS blowdown temperature
Aquatic Ecology	0.95 cm (0.375 in)	Size of CWS intake traveling screen openings
	0.15 m/s (0.5 fps)	Maximum through-screen velocity of CWS intake traveling screens
Meteorology – Air Quality		Waste heat from CWS to atmosphere
Meteorology – Air Quality, Terrestrial Ecology, Radiological Health, Socioeconomics	56 ft	CWS mechanical draft cooling-tower height
	225 ft	Height of tallest structure (shield building)
Socioeconomics	773 workers	Normal operating workforce for two units
	1573 workers	Maximum workforce during refueling outages lasting 25 to 30 days every 18 months (800 temporary workers in addition to normal operating workforce)
Terrestrial Ecology, Socioeconomics, Nonradiological Health	90 dBA	Nearfield maximum noise level (3 ft from source)
	28 dBA	Maximum noise level of main plant operations at nearest residence (2.6 km or 1.6 mi)
Radiological Health, Transportation, Need for Power	3415 MW(t)	Thermal output per unit
	1200 MW(e)	Gross electrical output per unit
Radiological Health, Transportation	93 percent	Expected annual capacity factor

Source: PEF 2009a

3.5 References

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."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

40 CFR Part 141. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 141, "National Primary Drinking Water Regulations."

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Progress Energy Florida, Inc. (PEF). 2009b. *Levy Nuclear Plant Units 1 and 2 COL Application, Part 2, Final Safety Analysis Report*. Revision 1, St. Petersburg, Florida. Accession No. ML092860737.

Progress Energy Florida, Inc. (PEF). 2009c. Letter from Garry Miller, PEF, to NRC, dated January 16, 2009, regarding Supplemental Information for Environmental Audit – Information Needs with Attachments. Accession No. ML090750822.

Progress Energy Florida, Inc. (PEF). 2009d Letter from Garry Miller, PEF, to NRC, dated March 27, 2009, regarding Response to Request for Addtional Information Regarding the Environmental Review. Accession No. ML091320050.

Progress Energy Florida, Inc. (PEF). 2009e. Letter from Garry Miller, ,PEF, to NRC, dated June 12, 2009, regarding Supplement 1 to Response to Request for Additional Information Regarding the Environmental Review. Accession No. ML091740487.

Progress Energy Florida, Inc. (PEF). 2009f. Letter from Garry Miller, PEF, to NRC, dated September 3, 2009, regarding Supplement 5 to Response to Request for Additional Information Regarding the Environmental Review. Accession No. ML092570297.

Resource Conservation and Recovery Act (RCRA). 42 U.S.C. 6901 et seq.

U.S. Army Corps of Engineers (USACE). 2009. *Public Notice – Permit Application No. SAJ-2008-490 (IP-GAH); Levy Nuclear Plant (LNP) – Progress Energy Florida, SAJ-2008-490 (IP-GAH), Sheet Index/Explanation for Public Notice*. Panama City, Florida. Accession No. ML090890419.

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4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with building the proposed Units 1 and 2 at the Levy Nuclear Plant (LNP) site as described in the application for combined construction permits and operating licenses (COLs) submitted by Progress Energy Florida, Inc. (PEF). As part of its application, PEF submitted (1) an Environmental Report (ER) (PEF 2009a), which discusses the environmental impacts of constructing the new nuclear units and provides information used as the basis for the environmental review and (2) a Final Safety Analysis Report (FSAR) (PEF 2009b), which addresses safety aspects of construction and operation.

As discussed in Section 3.3 of this environmental impact statement (EIS), the U.S. Nuclear Regulatory Commission's (NRC's) authority related to building new nuclear units is limited to construction activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57416). The NRC has defined "construction" according to the bounds of its regulatory authority. Many of the activities required to build a nuclear power plant do not fall within the NRC's regulatory authority and, therefore, are not construction as defined by the NRC. Such activities are referred to as "preconstruction" activities in Title 10 of the Code of Federal Regulations (CFR) 51.45(c). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of a COL. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

The U.S. Army Corps of Engineers (USACE) is a cooperating agency on this EIS consistent with an updated Memorandum of Understanding (MOU) signed with the NRC (USACE and NRC 2008). The NRC and the USACE established this cooperative agreement because both agencies have concluded it is the most effective and efficient use of Federal resources in the environmental review of a proposed new nuclear power plant. The environmental review described in this EIS was conducted by a joint NRC and USACE review team (composed of NRC staff, its contractors' staff, and staff from the USACE). In carrying out its regulatory responsibilities, the USACE will complete an independent evaluation of the applicant's Department of the Army (DA) permit application to determine whether to issue or deny a DA permit for this project. This decision will be documented in the USACE's Record of Decision (ROD), which will be issued after publication of the EIS.

USACE's ROD will reference the information in the EIS and present any additional information required by the USACE to support its permit decision. The USACE's role as a cooperating agency in the preparation of this EIS is to ensure to the maximum extent practicable that the information presented is adequate to fulfill the requirements of USACE permitting regulations.

The "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (40 CFR Part 230) contains the substantive environmental criteria used by USACE in evaluating discharges of dredged or fill material into waters of the United States. USACE's Public Interest Review (PIR) (33 CFR 320.4) directs the USACE to consider a number of factors as part of a balanced evaluation process. USACE's PIR will be part of its permit decision document and will not be addressed in this EIS.

On June 30, 2008, the USACE received copies of the State of Florida's Site Certification Application for the proposed project. The Site Certification Application served as the application for a DA permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act of 1899. The USACE evaluation of the application will consider both construction and preconstruction activities.

While both NRC and the USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.). The USACE regulatory authority related to the proposed action is based on Section 10 of the Rivers and Harbors Act (33 USC 403 et seq.), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the USACE, and Section 404 of the Clean Water Act (33 USC 1344 et seq.), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Therefore, the applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a USACE permit. A decision whether to issue a permit is typically made after the USACE evaluation and receipt of public feedback in the form of public comments on its draft environmental review. Because the USACE is a cooperating agency under the MOU for this EIS, the USACE's ROD of whether to issue a permit will not be made until after public comment has been received on this NRC/USACE draft EIS and the final EIS is issued.

The collaborative effort between the NRC and the USACE in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the staffs of the NRC and the USACE collaborated (1) in the review of the COL application and information provided in response to requests for additional information (RAIs; developed by the NRC and the USACE) and (2) in the development of the EIS. NRC regulations (10 CFR 51.45(c)) require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7. However, because of the collaborative effort between the NRC and the USACE in the environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of a COL and the preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a). Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) construction activities and the assessment of the combined impacts of construction and preconstruction are used in the description and assessment of cumulative impacts in Chapter 7.

For most environmental resource areas (e.g., terrestrial ecology), the impacts are not the result of either solely preconstruction or construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. Although, the majority of the impacts would occur as a result of preconstruction activities.

This chapter is divided into 13 sections. In Sections 4.1 through 4.10, the review team evaluates the potential impacts on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological and radiological health effects, and nonradioactive waste. An impact category level – SMALL, MODERATE or LARGE – of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas, for example, in the socioeconomic area where the impacts of taxes are analyzed, the impacts may be considered beneficial and are stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Applicable measures and controls that would limit the adverse impacts of building the proposed new units, where appropriate, are presented in Section 4.11. A summary of the construction impacts and the proportional distribution of impacts based on construction and preconstruction is presented in Section 4.12. References cited in this chapter are listed in Section 4.13. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10.

The review team's evaluation of the impacts of building proposed LNP Units 1 and 2 draws on information presented in PEF's ER and supplemental documents and the USACE permitting documentation, as well as other government and independent sources.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with building Units 1 and 2 at the LNP site. Topics discussed include land-use impacts at the LNP site, in the vicinity of the site, and in the region, and land-use impacts in the transmission-line corridors.

4.1.1 The Site, Vicinity, Region, and Offsite Areas

Land-use impacts of construction and preconstruction activities are discussed for the LNP site, as well as offsite areas, within the vicinity of the site (i.e., within the 6-mi radius), and the 50-mi region. The plant site includes the following: LNP Units 1 and 2, cooling towers, and associated support buildings:

- 500-kV switchyard,
- site access roads, and
- stormwater ponds.

Offsite areas include:

- transmission-line corridors (which are covered in Section 4.1.2),
- the heavy-haul road and barge slip access road,
- barge slip, and
- the makeup- and blowdown-water pipeline corridor and associated cooling-water intake and discharge structures.

The plant site facilities would be located on approximately 627 ac near the center of the site, which is approximately 20 percent of the total site area (PEF 2009c). Construction and preconstruction activities for these facilities would permanently convert the existing land use from primarily pine plantations, forested wetlands, and mixed forests to a transportation, communications, and utilities land-use category (PEF 2009a). The ground elevation of the reactors and cooling towers, which is currently located within the 100-year floodplain, would be raised 8 ft above the existing grade, so that the structures would be above the 100-year floodplain.

Approximately 150 ac on the site would be disturbed for temporary facilities, such as material storage areas, laydown areas, parking areas, and a temporary buffer surrounding the construction zone. Areas temporarily disturbed while creating these facilities would revert to open grassy areas after use of such facilities is completed, which would be a permanent conversion from pine plantations, forested wetlands, and mixed forests. During the building process, approximately 30 ac would be disturbed for temporary access to the transmission-line rights-of-way, heavy-haul road, and pipeline right-of-way, which would run from the LNP site to the Cross Florida Barge Canal (CFBC). Temporary access would be provided via a 50-ft buffer on one side of the common corridor (see Section 2.5), which would be restored to the original land-use type after building at the LNP site is completed (PEF 2009c). Lands within the common corridor would be permanently converted from mixed forest land, forested wetland, pine plantations, and nonforested wetland to a transportation, communications, and utilities land-use category.

Heavy equipment and reactor components would be barged from the Gulf of Mexico up the CFBC. A new barge slip would be built on the north bank of the CFBC at the end of the proposed barge slip access road. Approximately 1.1 ac would require dredging below mean high water and excavation of 1 ac would be required above mean high water. In total, this activity would permanently convert the existing land use for approximately 2.1 ac of mixed forests to streams and canals.

The barge slip access road would extend from County Road 40 (CR-40) south to the anticipated barge slip. A heavy-haul road would be built to transport heavy equipment and materials north from CR-40 to the LNP site and allow for ground transportation of heavy equipment and materials from the proposed barge slip. The roads would affect primarily mixed forested lands, forested wetlands, and other agricultural lands. Table 4-1 and Table 4-2 list the anticipated onsite and offsite land-use impacts. Roadways would be built to Florida Department of Transportation (FDOT) standards.

Table 4-1. LNP Onsite Land-Use Impacts by Major Component

Facility	Impact	Land-Use Type	Impact Area (ac)
Heavy-Haul Road	Permanent	Other open lands (rural)	0.3
		Tree plantations	5.9
		Cypress	1.1
		Wet planted pine	1.2
		Wetland forested mixed	0.6
		Wet prairies	0.1
Miscellaneous Fill	Permanent	Other open lands (rural)	3.7
		Tree plantations	39.2
		Cypress	7.2
		Wet planted pine	19.2
		Wetland forested mixed	1.8
		Freshwater marshes	0.1
		Wet prairies	0.1
		Treeless hydric savannah	41.3
Miscellaneous Pipeline	Permanent	Other open lands (rural)	0.7
		Tree plantations	1.5
		Cypress	0.3
		Wet planted pine	0.3
		Wetland forested mixed	1.6
		Wet prairies	0.0

Table 4-1. (contd)

Facility	Impact	Land Use Type	Impact Area (ac)
Miscellaneous Structures	Permanent	Other open lands (rural)	6.2
		Tree plantations	30.2
		Mixed wetland hardwoods	0.7
		Cypress	1.7
		Wet planted pine	17.1
		Wetland forested mixed	4.9
		Freshwater marshes	0.3
		Wet prairies	0.0
		Treeless hydric savannah	13.1
Pipeline LNP to CFBC	Permanent	Other open lands (rural)	1.0
		Tree plantations	7.2
		Cypress	1.9
		Wet planted pine	1.2
		Wetland forested mixed	3.7
		Wet prairies	0.3
		Treeless hydric savannah	0.4
Pond A	Permanent	Tree plantations	19.6
		Wet planted pine	30.1
		Wetland forested mixed	6.3
		Freshwater marshes	3.7
		Treeless hydric savannah	10.1
Pond B	Permanent	Other open lands (rural)	6.8
		Cypress	3.0
		Wet planted pine	0.0
		Wetland forested mixed	0.1
		Wet prairies	4.0
Pond C	Permanent	Tree plantations	15.6
		Cypress	2.5
		Wet planted pine	6.1
		Freshwater marshes	0.2
Shooting Range	Permanent	Tree plantations	0.1
Site Access Roads	Permanent	Other open lands (rural)	1.5

Table 4-1. (contd)

Facility	Impact	Land Use Type	Impact Area (ac)
		Tree plantations	15.4
		Cypress	2.5
		Wet planted pine	8.1
		Wetland forested mixed	1.0
		Treeless hydric savannah	0.7
Switchyard	Permanent	Tree plantations	28.4
		Cypress	5.3
		Wet planted pine	7.1
Switchyard Connection	Permanent	Other open lands (rural)	1.1
		Tree plantations	11.0
		Cypress	4.2
		Wet planted pine	5.1
		Freshwater marshes	0.0
		Wet prairies	0.1
		Treeless hydric savannah	1.7
Transmission Corridor	Permanent	Upland coniferous forests	0.1
		Tree plantations	100.5
		Mixed wetland hardwoods	9.5
		Cypress	24.1
		Wet planted pine	33.9
		Wetland forested mixed	8.4
		Freshwater marshes	2.0
		Wet prairies	0.3
LNP Unit 1	Permanent	Other open lands (rural)	5.5
		Wet planted pine	3.4
		Wetland forested mixed	0.7
		Freshwater marshes	2.0
		Treeless hydric savannah	3.8
LNP Unit 2	Permanent	Other open lands (rural)	4.3
		Tree plantations	2.9
		Wet planted pine	2.1
		Wetland forested mixed	0.0
		Freshwater marshes	3.7

Table 4-1. (contd)

Facility	Impact	Land Use Type	Impact Area (ac)
		Wet prairies	0.1
		Treeless hydric savannah	2.3
50-Foot Buffer to CFBC	Temporary	Other open lands (rural)	9.1
		Tree plantations	56.6
		Mixed wetland hardwoods	2.7
		Cypress	13.2
		Wet planted pine	39.5
		Wetland forested mixed	7.4
		Freshwater marshes	0.6
		Wet prairies	1.5
		Treeless hydric savannah	19.1
Subtotal Permanent			627.1
Subtotal Temporary			149.7
Total			776.8

Source: PEF 2009c.

Table 4-2. LNP Offsite Land-Use Impacts by Major Component

Facility	Impact	Land-Use Type	Impact Area (ac)
Blowdown Pipeline	Permanent	Extractive	4.5
		Open land	37.8
		Shrub and brushland	0.9
		Mixed rangeland	9.4
		Upland coniferous forest	2.3
		Pine flatwoods	3.8
		Longleaf pine – xeric oak	0.7
		Hardwood conifer mixed	16.9
		Tree plantations	6.5
		Streams and waterways	1.7
		Reservoirs	2.3
		Wetland forested mixed	2.2
		Freshwater marshes	6.5
		Saltwater marshes	4.5
		Transportation	1.6
		Utilities	14.6

Table 4-2. (contd)

Facility	Impact	Land-Use Type	Impact Area (ac)
Heavy-Haul Road	Permanent	Other open lands (rural)	6.6
		Upland coniferous forest	1.9
		Hardwood conifer mixed	0.1
		Tree plantations	23.1
		Cypress	5.3
		Freshwater marshes	2.5
Miscellaneous Pipeline	Permanent	Other open lands (rural)	1.2
		Hardwood conifer mixed	0.8
		Tree plantations	3.4
		Freshwater marshes	0.3
Pipeline CFBC to Crystal River Energy Complex (CREC)	Permanent	Other open lands (rural)	7.2
		Upland coniferous forest	1.5
		Hardwood conifer mixed	1.1
		Tree plantations	27.0
		Cypress	6.4
		Wetland forested mixed	0.2
		Freshwater marshes	2.6
Site Access Roads	Permanent	Upland coniferous forest	0.0
		Hardwood conifer mixed	0.0
		Tree plantations	3.6
		Cypress	0.8
		Freshwater marshes	0.6
		Transportation	0.1
		Utilities	0.2
Barge Slip and Access Road	Permanent	Other open lands (rural)	2.0
		Coniferous plantations	3.2
		Reservoirs	0.1
		Transportation	1.3
50-ft Buffer to CFBC	Temporary	Other open lands (rural)	8.4
		Upland coniferous forest	1.6
		Hardwood conifer mixed	1.8
		Tree plantations	11.8
		Cypress	3.8
		Wetland forested mixed	0.8
		Freshwater marshes	1.4
Permanent Subtotal			219.3
Temporary Subtotal			29.6
Total			248.9

Sources: PEF 2009c, CH2M HILL 2008.

Construction Impacts at the Proposed Site

In its Site Certification Application, PEF states that most of the fill material needed would come from onsite excavation activities, but 30 to 45 percent of it may have to be obtained from offsite borrow pits (PEF 2009d). This offsite material would be trucked onto the LNP site over the heavy-haul road. To minimize related impacts on surrounding land, the heavy-haul road would be collocated with the transmission-line corridor and the makeup-water and blowdown-water pipeline corridor. PEF selected the location of the proposed heavy-haul road because it is the shortest direct route to the LNP site from the barge slip, it is slightly higher in elevation, and it contains fewer wetlands than other potential locations that were considered (PEF 2009d).

Makeup-water and blowdown-water pipeline corridors and their associated structures would be built along or near the CFBC and connect the LNP to its primary source of water. The blowdown pipeline would connect LNP to the Crystal River Energy Complex (CREC). These facilities would result in permanent land-use changes from streams, waterways, reservoirs, wetlands, and marshes to transportation, communications, and utilities. Initially proposed routing of the blowdown pipeline south of the CFBC crosses several tidal creeks and would adversely impact approximately 4.5 acres of salt marsh habitat. The staff is aware that PEF has proposed to the FDEP an alternate route to avoid this important habitat. FDEP has not made a decision on the proposal. Impacts to habitat related to the discharge pipeline, irrespective of the final routing, would be primarily due to its excavation, placement, and burial associated with construction. The intake structures would be located 7 mi from the Gulf of Mexico along the CFBC's northern bank, and 0.5 mi from the Inglis Lock. The makeup-water pump house at the intake location would affect 1.1 ac of land already used for transportation, communications, and utilities.

PEF has not made a final determination regarding the source of the fill material for the LNP site. To provide additional context for the potential impacts of fill mining, the review team considered the impacts if the proposed Tarmac King Road Limestone Mine provided the source of fill. The proposed mine would be located 1 mi west of the intersection of U.S. Highway 19 (US-19) and King Road in Levy County, about 2 mi west of the LNP site. Additional information regarding the mine is provided in Chapter 7. Tarmac America LCC (Tarmac) has applied for permits to begin site development in 2011, with operations beginning in 2013. This limestone mine would be located on a 9400-ac aggregate mining site. The mined portion would include 2700 ac of wetlands and uplands. An additional 1300 ac would be used for the associated quarry, processing plant, roads, and buffers; 800 ac would be set aside for wetlands; and 4500 ac would be donated to the State of Florida for preservation. The Tarmac mine would not be developed solely for providing fill material to the LNP site. Therefore, only a portion of the impact of the mine would be considered directly attributable to the LNP project, if the Tarmac mine were the source for fill material at the LNP site.

To lessen the land-use impacts, PEF has indicated that it would use mitigation measures during construction and preconstruction activities, such as erosion control, controlled access roads, and restricted construction zones (PEF 2009a). Stormwater runoff from LNP corridors would be controlled by a stormwater-drainage system. Three stormwater ponds would be designed and constructed to fully contain the runoff from a 25-year, 24-hour rainfall. The stormwater collected in the ponds would infiltrate to groundwater or during exceptional rainfall events be drained through emergency spillways. The retained water could be pumped to the cooling-tower blowdown basin if necessary.

Land-use impacts on communities within the 50-mi region could result from the increased workforce (up to 3300 new employees) and associated increases in urbanized land uses, such as residences and commercial areas. PEF estimates that up to half of the workforce used to build the facility might decide to relocate to the LNP vicinity. It is anticipated that adequate housing (houses for rent or purchase, mobile homes, recreational vehicle/camping units, and public lodging in hotels or motels) and community services would be available to accommodate this influx of workers. The other half of the workforce would commute from other areas within the region. See Section 4.4.4.4 for discussion of the induced impacts to residential areas and community services from construction and preconstruction.

During construction and preconstruction activities for LNP Units 1 and 2, traditional hunting on the LNP site would be prohibited. However, hunting and fishing locations would be available in parks and recreational areas in the region.

Wetland impacts are discussed in Section 4.3.1. Coordination with the USACE to address Clean Water Act 404 requirements, including mitigation for wetland impacts, is ongoing. Prior to receipt of a USACE permit (if issued), PEF may not commence activities in jurisdictional waters, including wetlands.

Onsite, at least 627 ac of land would be permanently converted to a new land use. In addition, several offsite areas would have permanent land-use impacts, such as the heavy-haul road, the blowdown pipeline corridor, the intake facility, and the corridor for the makeup-water pipeline. These permanent land-use impacts would be detectable, but would not noticeably alter the existing land uses within the vicinity and region.

4.1.2 Transmission-Line Corridors

10 CFR 50.10(a)(2) specifically states that building transmission lines is not considered an NRC-authorized construction activity. There would be no transmission-line corridor impacts from NRC-authorized construction activities. However, the review team is analyzing these impacts here to support the USACE's analysis. Transmission-line siting in Florida is regulated under the Florida Power Plant Siting Act (PPSA) (29 Fla. Stat. 403), and Chapter 62-17 of the Florida Administrative Code (FAC) (Fla. Admin Code 62-17). Although the precise rights-of-way for the proposed new transmission lines have not yet been determined, the locations of conceptual transmission-line planning corridors are shown in Figure 2-5.

Table 4-3 lists the land-use impacts for representative corridors within the wider conceptual corridors. The review team expects that somewhat less acreage than the entire planning corridor described in Section 2.2.2 would be required to site transmission line rights-of-way due to several factors. Finalized siting plans and permitting conditions that would be imposed by the various affected State and local agencies would minimize the footprint of the corridors. Engineering considerations and costs are likely to suggest designs that favor collocation with existing transmission lines in existing corridors. The review team based these expectations on its review of the State of Florida's Conditions of Certification (FDEP 2010a), which lists each affected agency's specific permitting conditions, and also on commitments made by PEF to use existing corridors to the extent practicable (PEF 2009a). Specific State conditions that would minimize changes in land disturbance and land use include the following:

- Rights-of-way are to be collocated "to the extent feasible with or adjacent to existing public rights-of-way."
- Rights-of-way are to "avoid the taking of homes."
- Rights-of-way are to "avoid Outstanding Florida Waterbodies (OFW) to the extent feasible and practicable," and can only locate in such areas upon demonstrating how doing so "is clearly in the public interest."

PEF proposes four new 500-kV transmission lines and four new 230-kV transmission lines to serve Units 1 and 2 at the LNP site. All transmission lines would share a common corridor that exits to the south of the LNP site, then turns east at the CREC. The proposed Citrus substation is located approximately 9 mi south of the LNP site. The transmission-line corridor would be approximately 1000 to 2640 ft wide and 59 mi long.

In addition, several new transmission lines would be required beyond the first substation to integrate power from the proposed LNP into the Florida electrical grid. These lines would include four 230-kV lines and one 500-kV line. Two of the 230-kV lines would run from the proposed Citrus substation to the Crystal River East substation (both in Citrus County); one would run approximately 38 mi south from the CREC 500-kV switchyard in Citrus County to the existing Brookridge substation in Hernando County; and one would originate at the existing Kathleen substation in Polk County, run south to the existing Griffin substation in Hillsborough County, and then west, terminating at the existing Lake Tarpon substation in Pinellas County. The 230-kV transmission line would run from the Brookridge substation to the Brooksville West substation (both in Hernando County) (FDEP 2010a). Two 69-kV transmission lines would be required to support activities related to building the facility, both connecting to existing lines and entering the LNP site from the western and southern borders. These lines would require about 4.6 mi of new transmission-line corridors (PEF 2008a).

The review team expects that the dimensions of each transmission segment would conform to dimensions described in the Florida Department of Environmental Protection (FDEP) Conditions of Certification (FDEP 2010a) as follows:

1 **Table 4-3**. Land-Use Impacts within Representative Transmission-Line Corridors in Acres

FLUCFCS	Land Use/ Habitat	Levy/Citrus Common Corridor	Citrus	Crystal River East	Sumter	Brook-ridge	Brooksville West	Kathleen	Total Acre-age	Percent by Land Cover
411	Pine Flatwoods	16.1	0	0	10.7	0	0	3.4	30.2	1.7
412	Longleaf Pine – Xeric Oak	0	152.4	1.1	25.1	6.4	1	0	186	10.4
413	Sand Pine	0	0	0	54.2	1.3	0	0	55.5	3.1
421	Xeric Oak	0	0	0	97.4	0.3	0	0	97.7	5.5
424	Melaleuca	0	0	0	0	0	0	0.3	0.3	0
427	Live Oak	0	0	0	11.3	0	0	0	11.3	0.6
434	Hardwood – Conifer Mixed	75.7	177.1	71.5	191.2	0.1	0	31.8	547.4	30.6
441	Coniferous Plantations	138.9	0	0	106.9	0.5	0	0.6	246.9	13.8
510	Streams and Waterways	1.2	0.1	0	0.2	0	0	0.6	2.1	0.1
520	Lakes	0	0	0	0.9	0	0	0.9	1.8	0.1
530	Reservoirs	0	0.2	0	0.1	0	0	6.3	6.6	0.4
534	Reservoirs <10 ac	0	0	0	0	0	0	0.4	0.4	0
615	Stream and Lake Swamps (Bottomland)	0	11.6	1.3	25.7	0	0	3.4	42	2.4
621	Cypress	185.2	2.7	1	0.4	0	0	2.4	191.7	10.7
624	Cypress – Pine – Cabbage Palm	2.6	0	0	0	0	0	0	2.6	0.1
630	Wetland Forested Mixed	23	2.4	1.3	0.1	0	0	3.8	30.6	1.7
631	Wetland Scrub	0	0	0	0	0	0	0.1	0.1	0
641	Freshwater Marshes	0	10.3	5.9	9.6	1.1	0	32.4	59.3	3.3
643	Wet Prairies	0.6	0	0	3.9	0	0	0.9	5.4	0.3
653	Intermittent Ponds	0	0	0	0	0	0	0	0	0
830	Utility Right-of-Way	2.6	0.3	35	50.9	130.2	7.2	43.1	269.3	15.1
	Total Disturbed Acreage	445.9	357.1	117.1	588.6	139.9	8.2	130.4	1787.2	100
	Percent by Corridor	24.9	20	6.6	32.9	7.8	0.5	7.3	100	

Sources: PEF 2009c and FDOT 1999.
Notes: The Levy North South Corridor is subsumed within the total for the Levy/Citrus Common Corridor.
FLUCFCS = Florida Land Use, Cover and Forms Classification System.

- Citrus corridor: This entirely new 500-kV corridor, also known as the LPC corridor, would accommodate rights-of-way for two 500-kV transmission lines originating at the LNP switchyard and traversing 2 mi of the LNP site and the southern property. From the southern boundary of the southern property, it would then traverse south for approximately 7 mi, terminating at the proposed Citrus substation in Citrus County, Florida. Each 500-kV line typically would require a width of 200–220 ft, but by optimizing design, less width may be needed.

- Crystal River corridor: Also known as the LCR corridor, this 500-kV corridor is approximately 14 mi long. From the LNP to the existing PEF 500-/230-kV transmission line, the transmission lines would likely be collocated with three other proposed 500-kV transmission lines (the two Citrus transmission lines and the Sumter transmission line) within the Levy/Citrus common corridor. From CR 488 (West Dunnellon Road), the Crystal River corridor proceeds south to the existing PEF 500/230-kV transmission-line right-of-way, where it turns west centered on the existing PEF 500/230-kV transmission-line right-of-way alignment to the CREC switchyard. A single, new 500-kV transmission line is proposed for the 500-kV of this corridor. The proposed collocation with other proposed and existing 500-kV transmission lines may allow a reduction in the typical right-of-way width.

- Sumter corridor: From the LNP to the existing PEF 500/230-kV transmission line, the 500-kV Sumter corridor (also known as the LCFS corridor) would be collocated with the three other proposed 500-kV transmission lines (the two Citrus transmission lines and the Crystal River transmission line) in the Levy/Citrus common corridor. For most of the rest of its length, the 500-kV Sumter corridor will be collocated with existing PEF transmission lines. The corridor is approximately 59 mi long, and typically 200–220 ft wide, and would terminate at the proposed Central Florida South Substation near the City of Leesburg in Lake County, Florida. The proposed collocation with other proposed and existing 500-kV transmission lines likely would allow a reduction in the typical right-of-way width.

- Brookridge corridor: Also known as the CB corridor, the 230-kV Brookridge corridor originates at the CREC switchyard in Citrus County and terminates at the existing Brookridge substation in Hernando County. The overall length of the corridor is approximately 38 mi. The corridor would be collocated with PEF’s existing transmission-line rights-of-way for most of its length. Each 230-kV line typically would require 100 ft of corridor width, but by optimizing design and collocation, less width may be needed.

- Brooksville West corridor: The 230-kV Brooksville West corridor (also termed the BBW corridor) originates at the existing Brookridge substation, traverses south, and terminates at the existing Brooksville West substation in Hernando County, Florida. The overall length of the corridor would be approximately 3 mi and be collocated with the existing PEF 500/230/115-kV transmission-line right-of-way. Each 230-kV line typically would require 100 ft of corridor width, but by optimizing design and collocation, less width may be needed.

- Kathleen corridor: The 230-kV Kathleen corridor (also termed the PHP corridor) originates at the existing Kathleen substation in Polk County and terminates at the existing Lake Tarpon substation in Pinellas County. The overall length of the corridor is approximately 50 mi. The proposed corridor would be collocated with PEF's existing 230-kV transmission-line right-of-way from the Kathleen substation to the Griffin substation. The 230-kV transmission line would replace the existing 115-kV transmission-line from the existing Griffin substation to the existing Lake Tarpon substation. Each 230-kV line typically would require 100 ft of corridor width, but by optimizing design and collocation, less width may be needed.

- Crystal River East corridor: The 230-kV Crystal River East corridor (also termed the CCRE corridor) originates at the proposed Citrus substation and traverses east and crossing US-19. Then the corridor makes a right-angle, turning south toward the existing Crystal River East substation, and ending approximately 0.25 mi south of the existing PEF 500/230-kV transmission-line right-of-way, for a total run of 0.75 mi each. Each 230-kV line typically would require 100 ft of corridor width, but by optimizing design and collocation, less width may be needed.

- Levy North-South corridor: This corridor would be used to supply offsite power to the LNP site via 69-kV lines. The north portion is a small 375 ft segment linking the LNP site with an existing 69-kV transmission line just west of US-19. The south portion is approximately 4.5 mi long. A right-of-way up to 70 ft wide would be required, which would be reduced within the Levy/Citrus common corridor and wherever the right-of-way would run adjacent to an existing road right-of-way. Because it is subsumed by the Levy/Citrus common corridor, this corridor is not identified separately in Table 4-3.

Based on Table 4-3, a total of about 1790 ac of land would be disturbed by placement of new transmission lines in corridors PEF is proposing (PEF 2009c). Of this total, about 18.6 percent is classified as wetlands under the Florida Land Use, Cover and Forms Classification System (FLUCFCS), with 65.8 percent of the total in forested lands, 0.6 percent crossing open water, and the remaining 15.1 percent crossing existing utility right-of-way including agricultural land. Wetland impacts are discussed in more detail in Section 4.3.1.1.

In its ER (PEF 2009a), PEF reports that corridor development and transmission-line placement would include erosion control, corridor preparation, placement of foundations, assembly and erection of structures, and installation of conductors. PEF has committed to minimizing the effects on human populations, waterbodies and wetlands, archaeological and historic sites, vegetation, and wildlife to the extent practicable by complying with State and Federal regulatory requirements, including the specific conditions outlined in the Conditions of Certification (FDEP 2010a) discussed previously in this section.

PEF indicates that the entire width of the transmission-line corridor would be completely cleared except within wetland areas. In general, proposed transmission lines that would be collocated with existing transmission lines would use portions of the existing right-of-way. However, for areas where existing right-of-way widths are insufficient for placement of the proposed collocated transmission lines, additional land clearing would be necessary (PEF 2009a).

Because transmission-line corridors would pass through a number of undisturbed lands, including wetlands, PEF has identified several measures it would take to mitigate the impacts on the environment. Upland areas would be cleared and covered with a chipping material. Corridors that pass through wetlands would be cleared, although vegetation and trees would be cut back to avoid clearing where possible. Trees that are cut down would have their stumps and root systems left intact where possible. After the transmission lines have been installed, the land in the corridors would be maintained in an herbaceous state. Where practicable, vegetated areas 25 ft wide forming deep foliage screens with mature heights not exceeding 12 ft would be left intact where the corridor crosses navigable waterways. In addition, the State of Florida Conditions of Certification would help minimize land-use impacts. For example, according to FDEP (2010a), to ensure that impacts are minimized, "…where practicable, the length of the span between transmission line structures shall be varied and other design changes made, which shall include but not be limited to a reduction in pad size, elimination of access roads, use of finger fill from existing rights-of-ways (ROWs) and/or modification of construction techniques shall be considered…."

Based on information provided by PEF and the review team's independent review, the review team concludes that because of the amount and breadth of land to be affected by new transmission-line corridor development, the development activities would be somewhat noticeable to the public and there would be the potential for more than minor acreages to be converted from forested land to utility corridor land use. However, these impacts, while noticeable, are not expected to be destabilizing with respect to land use and would be mitigated as already described. Because the NRC does not authorize the building of transmission lines, the incremental impact from NRC-authorized activities would be negligible.

4.1.3 Summary of Land-Use Impacts

The review team evaluated the construction and preconstruction activities related to building proposed LNP Units 1 and 2 and the potential land-use impacts at the site and vicinity, in the region, and in the potential transmission-line corridors. Onsite, at least 627 ac of land would be permanently converted to a new land use. In addition, 219 ac of offsite areas would have permanent land-use impacts, such as the heavy-haul road, the blowdown pipeline corridor, the intake facility, and the makeup-water pipeline corridor. Transmission-line corridors would require about 1790 ac of land disturbance. These land-use impacts would be detectable, but would not noticeably alter the existing land uses in the vicinity and region. Transmission lines would noticeably alter, but not destabilize, local land uses, especially for new transmission lines that are not collocated with existing transmission lines.

Based on information provided by PEF and the review team's independent evaluation, the review team concludes that the land-use impacts of construction and preconstruction activities including those from placement of the transmission lines would be MODERATE, and PEF described the following mitigation activities to reduce such impacts: clearing and covering upland areas with a chipping material, avoiding clearing in wetland areas where possible, leaving stumps and root systems intact where possible, and maintaining land in corridors in an herbaceous state. Where practicable, PEF would leave intact vegetated areas 25 ft wide forming deep foliage screens with mature heights not exceeding 12 ft where the corridor crosses navigable waterways. In addition, the FDEP Conditions of Certification would help minimize land-use impacts. No further mitigation beyond the actions stated above would be warranted.

In Chapter 4.0 of the ER, PEF estimated that 95 to 100 percent of the land-use impacts would be the result of preconstruction activities, such as clearing, grading, building roads, excavation, erection of support buildings, and placement of the transmission lines (PEF 2009a). NRC's Limited Work Authorization (LWA) rule (72 FR 57416) specifically indicates that transmission lines and other offsite activities are not included in the definition of NRC-authorized construction. Because NRC-authorized construction activities represent only a part of the analyzed activities and because NRC does not authorize transmission-line installation activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that no further mitigation measures beyond PEF's commitments and the FDEP Conditions of Certification would be warranted.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts that would be associated with building of any large industrial construction project. Prior to initiating building activities including any site-preparation work, PEF would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. Below is a list of the hydrological-related authorizations, permits, and certifications potentially required from Federal, State, regional, and local agencies. Additional detail regarding the items listed is contained in Appendix H.

- <u>Clean Water Act Section 401 certification</u>. This certification is issued by the FDEP as part of Florida's PPSA Certification and ensures that the project does not conflict with State water-quality standards. This certification is required before the NRC can issue a COL to PEF.

- Department of the Army (DA) Permit (USACE). Authorization from the USACE would be required under Section 404 of the Clean Water Act for the discharge of fill or dredged material into waters of the United States associated with the site preparation activities and construction of the nuclear power plant and its associated components, including electrical transmission lines and substations, access roads, a barge slip at the Cross Florida Barge Canal (CFBC), cooling-tower makeup-water pipeline with an intake structure at the CFBC, and blowdown pipelines. Authorization would also be required under Section 10 of the Rivers and Harbors Act of 1899 for the construction or placement of structures, dredging, and the discharge of fill or dredged materials into or over navigable waters of the United States associated with the construction of the nuclear power plant and its associated components.
- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in Florida to the FDEP. The NPDES permits are part of PPSA certification. A stormwater pollution prevention plan (SWPPP) would be required.
- Water-use permit. Consumptive use of surface water or groundwater would require a permit from the FDEP or the water management district.
- Groundwater well drilling and operating permits. Construction of water wells would require a permit from the Southwest Florida Water Management District (SWFWMD).

4.2.1 Hydrological Alterations

Building the proposed Units 1 and 2 at the LNP site would alter several bodies of surface water and some of the aquifers underlying the site. Surface water resources that may be affected include the wetlands located in the area where proposed Units 1 and 2 would be located and the CFBC. Building LNP Units 1 and 2 would require excavation and/or dredging for installation of a barge-unloading facility and the intake structure for the circulating-water system on the CFBC and the installation of the blowdown discharge line from Units 1 and 2 to the Crystal River Discharge Canal.

Other activities would require alteration of the land surface in the vicinity of the proposed units. These alterations include clearing and grading for new and upgraded roadways. These land surface modifications would alter surface-water runoff flow patterns and the infiltration properties of the land surface.

Building LNP Units 1 and 2 and their ancillary facilities would occur within the 100-year floodplain and a portion of the offsite transmission line would be located within the 100-year floodplain (PEF 2008a). The State of Florida requires that any encroachment on the 100-year floodplain that may result in loss of flood storage be compensated (Fla. Admin. Code 40D-4.301 and 40D-4.302) such that no net encroachment occurs (SWFWMD 2009).

Building in floodplains may result in two effects: (1) encroachment up to the 100-year floodplain elevation above the seasonal high-water level (SHWL) and (2) encroachment below the SHWL in natural depressions including wetlands and sloughs. The first of these effects results in loss of detention storage capacity of the floodplain and the second results in loss of retention storage capacity of the landscape. The second of these effects is also called historic basin storage (HBS). The SWFWMD's bases of review regarding water quantity for Environmental Resource Permit (ERP) applications do not allow any net encroachment into the floodplain up to the 100-year event (SWFWMD 2009). If compensating floodplain storage is required for a project, it must be provided between the SHWL and the 100-year flood level. In addition, the SWFWMD also requires replacement or mitigation of the loss of HBS because of the project (SWFWMD 2009).

PEF performed a bounding analysis to conservatively estimate the loss of floodplain storage because of building and fill needed for the LNP facilities (CH2M HILL 2009a). PEF used a high-resolution digital elevation data set for the LNP site, Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), and a map of LNP facilities including the blowdown pipeline and transmission-line corridor to estimate the areas, called floodplain map units, where floodplain loss would occur because of building. PEF defined the floodplain fill and the HBS as the volumes of fill above and below, respectively, the seasonal high groundwater (SHGW) elevation (CH2M HILL 2009a). PEF estimated the SHGW elevation using wetland, soil, and hydrologic information for connected floodplain map units (CH2M HILL 2009a). PEF did not consider floodplain storage loss in isolated or unconnected floodplain map units. PEF stated that increased flood levels because of filling the isolated floodplain map units would be wholly contained on the LNP site. The review team determined that this is a reasonable assumption because the area of the isolated floodplain units on the LNP site is relatively minor (less than 7 percent) compared to that of the connected floodplain units. Flood storage currently provided by the isolated or non-contiguous floodplain units would run off and would be collected in the stormwater ponds after construction of the LNP facilities where it would infiltrate into the soil. PEF has performed a more detailed hydrologic and hydraulic modeling of the LNP site as part of the requirements of the Conditions of Certification for the LNP Units 1 and 2 (FDEP 2010a and PEF 2010c). The analysis is currently under review by the FDEP.

PEF estimated the 100-year floodplain elevation for the floodplain map units using the high-resolution 1-ft ground elevation contours and the FEMA FIRMs. PEF estimated the normal pool elevation, defined as the elevation of standing water in wetlands for several weeks during the wet season, for the floodplain map units based on site knowledge which required site inspection to qualitatively determine historical wetland water levels. The normal pool elevation for each floodplain map unit was set 1 ft above the average bottom elevation of the unit. PEF estimated the floodplain fill volume to be 252.4 ac-ft and the HBS to be 73.9 ac-ft because of building of LNP facilities (CH2M HILL 2009a).

PEF estimated the rise in level of the 100-year flood because of the LNP encroachment on the floodplain by distributing the lost volume on the remaining floodplain area within the LNP site boundary downstream of the facilities (CH2M HILL 2009a). The estimated rise is 0.22 ft.

PEF also identified upland areas that may be available for compensating the floodplain storage and HBS loss considering habitat data, land use and cover classifications, natural areas inventory, and other resources (CH2M HILL 2009a). PEF estimated that up to 320.9 ac-ft of compensation volume above SHGW elevation could be provided on the LNP site on a 322-ac area (CH2M HILL 2009a). Because floodplain storage loss is estimated to be 252.4 ac-ft, PEF concluded that volume compensation for floodplain storage loss could be provided onsite. PEF stated that compensation for HBS could be provided by excavating below the SHGW elevation in the same areas where floodplain compensation loss is provided (CH2M HILL 2009a). The area required for compensating 73.9 ac-ft with an average excavation of 0.5 ft would be 148 ac, which is only a portion of the 322 ac available for compensation.

The review team determined, based on its review of Florida regulations and PEF's description of the floodplain storage loss compensation, that sufficient onsite area is available to meet the requirements of the FDEP and SWFWMD (Florida Administrative Code 40D-4.301 and 40D-4.302 and SWFWMD 2009).

Hydrologic alterations also will result from grading and building a series of stormwater-drainage ditches. These surface modifications will result in changes in the rate and distribution of surface recharge and may affect groundwater levels beneath the LNP site. Stormwater-drainage ditches will direct runoff into three stormwater-retention and infiltration ponds. Any excess rainfall will be pumped to the cooling-tower blowdown basin and, if necessary, discharged with blowdown. The retention ponds are designed for a 25-year, 24-hour rainfall event. During larger storm events, pond overflow will be released through broad-crested weir emergency spillways.

The local groundwater aquifers that could be affected by the building of proposed LNP Units 1 and 2 are the surficial and Upper Floridan aquifers. Surface modifications will alter the thickness of the surficial aquifer and the nature and location of recharge and discharge zones. During building, anticipated hydrologic alterations include temporary changes in the groundwater levels associated with dewatering of excavations for the proposed structures. The current conceptual foundation design calls for substantial dewatering of each nuclear island area (containing the containment vessel, shield building, and auxiliary building) to depths of approximately 100 ft below the existing grade (PEF 2009b). Under this design, subsurface grouting and diaphragm walls would be used to isolate the excavation and minimize the impacts of dewatering on surrounding groundwater levels. Grouted diaphragm walls would be installed to minimize lateral groundwater inflow, and grout would be injected into the carbonate rock below the planned excavation depth to minimize upward groundwater flow into the excavation. These two engineered barriers would allow the excavation to be dewatered and minimize the amount of drawdown that occurs outside the grouted excavation. Thus, the impact of nuclear island dewatering on the surrounding groundwater system is expected to be minor.

Localized, short-term, building-related dewatering of the surficial aquifer outside the nuclear island excavation (e.g., dewatering of shallow trenches for pipelines and other utilities) would occur over a relatively small portion of the LNP site, primarily within the footprint of the LNP site boundaries and along the makeup-water and blowdown pipeline corridor. These are areas where existing wetlands would be drained or backfilled, and affected wetlands will be mitigated through Florida's Regional Offsite Mitigation Area plan. Wetlands located outside these impact areas would not be significantly affected by building-related dewatering. Once final designs are submitted, these dewatering activities will require approval from FDEP and the Southwest Florida Water Management District (SWFWMD).

The Upper Floridan aquifer may be affected because water for building activities would be obtained from wells screened within this aquifer. Building-related groundwater-use impacts are discussed in Section 4.2.2. Alteration of groundwater elevations resulting from building-related groundwater usage were evaluated based on the results of a local-scale groundwater flow model (see discussion in Sections 2.3.1.2 and 4.2.2). Effects of groundwater withdrawals during construction were not simulated. Instead, conclusions were drawn based on modeling of withdrawals during plant operation. These withdrawals will be much greater than withdrawals during construction. Results from the predictive simulations of withdrawals during plant operation indicate that groundwater withdrawal from the Upper Floridan aquifer at a rate of 1.5 Mgd would, after 1 year of pumping, result in surficial aquifer drawdowns of as much as 1.5 ft in areas where wetlands are present (Figure 4-1). A rate of 1.5 Mgd was used for the simulations because the wellfield would be permitted to withdraw that much water (FDEP 2010a). PEF indicates that the average water withdrawal rates for building activities would be 275,000 gpd and maximum rates would be 550,000 gpd, so drawdowns in the surficial aquifer are expected to be less than those predicted in the simulations. As noted in Section 2.3.1.2, water levels in the surficial aquifer have been observed to fluctuate 5 ft in a year at the LNP site due to normal seasonal variability (see discussion of potentiometric surfaces in Section 2.3.1.2).

Another potential hydrologic alteration that was considered in the evaluation was mining of fill material used during building activities at the LNP site. Whereas PEF has not made a final determination regarding the source of the fill material for the LNP site, to provide the reader with additional context of the potential impacts of fill mining, the review team considered the impacts of mining at the proposed Tarmac King Road Limestone Mine. Due to its proximity to the LNP site, this evaluation will provide maximal impact in the vicinity of the LNP site with regards to hydrological alterations. The proposed mine would be located 1 mi west of the intersection of US-19 and King Road in Levy County, about 2 mi west of the LNP site. Additional information

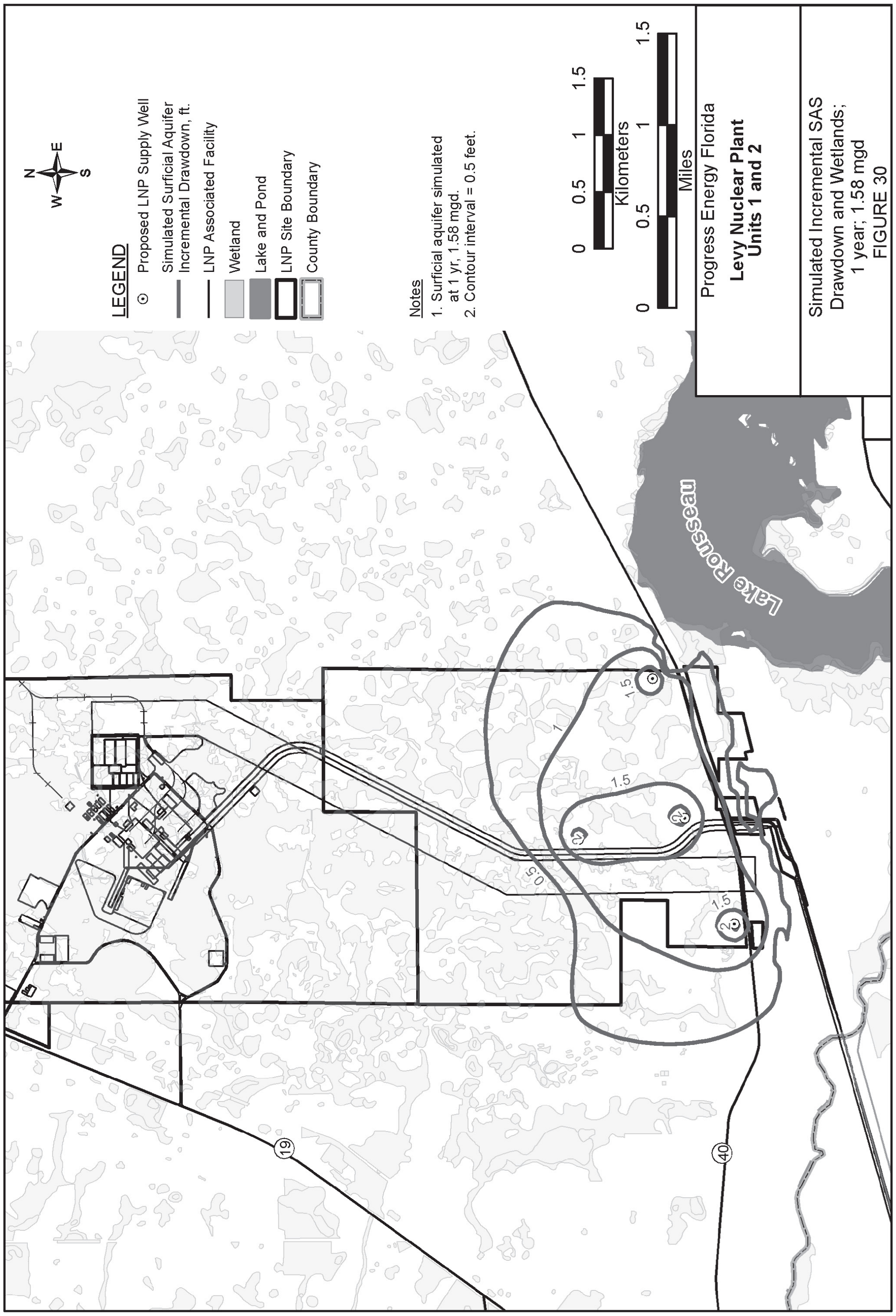


Figure 4-1. Simulated Incremental Surficial Aquifer Drawdown for 1 Year of Pumping at the Annual Average Usage Rate (PEF 2010a)

regarding the mine is provided in Chapter 7. Tarmac has applied for permits to begin site development in 2011, with operations beginning in 2013. This limestone mine is expected to use less than 1 Mgd of water (PEF 2009a), which is comparable to LNP operational usage. Although no evaluation of the impacts of water use at the Tarmac mine on groundwater levels and wetlands was performed, the review team determined that the effects would be of the same order of magnitude as those predicted for the LNP wellfield. As discussed in Section 5.2.2.2, a modeling evaluation indicated that average LNP operational groundwater use (1.58 Mgd) represents only a small percentage (0.8 percent) of the total water flux (208 Mgd) moving through the groundwater model domain. Assuming similar geohydrologic conditions at the Tarmac site, the review team determined that the proposed water use would also be a relatively small amount of the flux moving through the groundwater system. The Tarmac mine would not be developed solely for providing fill material to the LNP site, therefore only a portion of the impact of the mine would be considered directly attributable to the LNP project, if the Tarmac mine was used as the source of fill at the LNP site. The FDEP conditions of certification require PEF to develop an environmental monitoring plan, which includes a hydraulic testing program during drilling and installation of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater usage impacts without significantly affecting water levels in the surficial aquifer. The FDEP Conditions of Certification require that operational impacts of the LNP wellfield limit drawdowns in the surficial aquifer to levels that ensure no adverse impacts on wetlands.

During installation of the proposed new transmission lines (discussed in Section 4.1.2), hydrologic alterations to offsite surface waterbodies could occur. No surface or groundwater would be used in the installation of these lines. Although the exact routes are not yet determined, the lines would cross numerous waterbodies and wetlands. Best management practices (BMPs) would be applied for erosion and sedimentation control.

In summary, the hydrologic alterations associated with construction and preconstruction activities at and near the LNP site would include dredging for the intake structure, barge slip, and discharge pipeline; altering the surface topography; changes to runoff and infiltration characteristics (e.g., site grading, laydown yards, stormwater-collection trenches, and basins); dewatering the excavations for the nuclear island and intake structure; and groundwater withdrawal to supply water to building activities. Offsite hydrologic alterations are associated with the proposed new transmission-line corridors where they cross wetlands or surface waters. The impacts of hydrologic alterations resulting from both onsite and offsite activities would be localized and temporary, and the required permits, certifications, and the SWPPP call for the implementation of BMPs to minimize impacts.

4.2.2 Water-Use Impacts

The impacts of building a nuclear power plant on water use are similar to impacts that would be associated with the development of any large industrial site. This section includes identification of the proposed activities associated with building LNP Units 1 and 2 that could affect water use, and analysis and evaluation of proposed practices to minimize adverse impacts on water use by these activities. The impacts on the use of surface water and groundwater are discussed in this section. Water quality impacts on surface water and groundwater are discussed in Sections 4.2.3.1 and 4.2.3.2, respectively. Information in this section is drawn from the ER (PEF 2009a) and supplemental information provided by PEF, as referenced.

PEF does not intend to use surface-water during building of proposed LNP Units 1 and 2.

Raw water for building activities (e.g., soil compaction, dust and erosion control, and concrete mixing) will be withdrawn from onsite water-supply wells completed in the Upper Floridan aquifer. As discussed in Section 5.2.2.2, LNP operational usage of groundwater from the Upper Floridan aquifer is small relative to the overall model water balance. Because groundwater usage while building the proposed units is expected to be less than half that used during plant operations and the review team concludes that impacts of operational groundwater usage would be minor, building-related groundwater-use impacts also are expected to be minor.

Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the water-use impacts of construction and preconstruction activities would be SMALL, and mitigation beyond the State of Florida's Conditions of Certification (FDEP 2010a) would not be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that mitigation beyond the FDEP conditions of certification would not be warranted.

4.2.3 Water-Quality Impacts

Impacts on the quality of the water resources of the LNP site are described for surface-water and groundwater features that are most directly affected by building activities.

4.2.3.1 Surface-Water-Quality Impacts

Surface-water quality of nearby waterbodies would most likely be affected by surface-water runoff from the site during preparation and building of the facilities. Dredging in the CFBC to facilitate building of the intake structure, barge slip, and discharge line could also affect surface-water quality. The FDEP requires PEF to develop an erosion and sediment control plan and a SWPPP (PEF 2009a). The plans would be developed prior to initiation of site disturbance activities and would identify control measures to be used during site preparation activities to mitigate erosion and control stormwater runoff (PEF 2009a).

Building of some LNP facilities would occur within the 100-year floodplain as described in Section 4.2.1. As stated above, the review team determined, based on its review of Florida regulations and PEF's description of the floodplain storage loss compensation, that sufficient onsite area is available to meet the requirements of the FDEP and SWFWMD (Florida Administrative Code 40D-4.301 and 40D-4.302 and SWFWMD 2009). Therefore, the increase in the 100-year flood elevation downstream of the LNP site would not be noticeable after compensation is provided for floodplain fill and HBS losses.

The plan would identify BMPs to control the impacts of stormwater runoff. As discussed in Chapter 3, PEF would install three stormwater retention and infiltration ponds. Drainage ditches would be built to control delivery of sediment from the disturbed area to onsite waterbodies. Sediment carried with stormwater from the disturbed area would settle in the retention and infiltration ponds, and the stormwater would infiltrate into the shallow aquifer. Because the delivery of sediment from the disturbed area would be minimized by the use of BMPs and controlled by the stormwater ponds, the effects on off-site water quality are expected to be minor. The building of the stormwater drainage ditches would also be temporary and sediment delivery during this activity would also be minimized by use of BMPs and would remain localized. Therefore, the effects on off-site water quality from the building of stormwater drainage ditches are expected to be minor.

Dredging activities in the CFBC for the intake structure, the barge slip, and the blowdown discharge line may also result in disturbance of sediments and in a potential increase of turbidity near these locations. As discussed in Chapter 3, a temporary cofferdam and turbidity curtain would be used during excavation of the intake structure to control water-quality impacts. For the intake structure, barge slip, and blowdown discharge line installation, the hydrological alterations resulting from site development would be localized and temporary. Permits, certifications, and SWPPP require the implementation of BMPs to minimize impacts. Based on information provided by PEF and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities on surface-water quality at the site would be temporary and SMALL, and no further mitigation, other than the BMPs discussed, would be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities on surface-water quality would be temporary and SMALL, and no mitigation other than BMPs would be warranted.

4.2.3.2 Groundwater-Quality Impacts

Dewatering of the foundation excavations would be required to build the powerblock (which includes the reactor building, the radioactive waste building, the turbine building, service buildings, and associated structures). Water from the excavations would be intermittently pumped and discharged to temporary retention basins and settling ponds, which allow discharge water to infiltrate back into the surficial aquifer. Measures would be implemented, such as sedimentation traps or filtration, to ensure that erosion or siltation caused by the dewatering would be negligible (PEF 2009a). The potential also exists for stormwater infiltration to transport pollutants (e.g., gasoline) to the surficial aquifer. Impacts on groundwater quality would be monitored and controlled using the Florida BMPs for stormwater management (FDEP 2010b). As such, the review team expects these impacts to be minor.

PEF committed to complying "with federal, state, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental effects (for example, solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, and hazardous waste management)" (PEF 2009a). The Conditions of Certification issued by the State of Florida require that:

1. If hazardous substances are used in the construction or maintenance of the Certified Project, PEF shall provide the DEP with reasonable assurances that such hazardous substances will not enter stormwater drains or waterbodies.

2. Fuel and other petroleum product spills that enter stormwater drains or waterbodies, or fuel and other petroleum product spills that are in excess of 25 gallons shall be contained, cleaned up, and immediately reported to the appropriate DEP District Water Resources Office. A copy of any submittal by PEF pursuant to this paragraph, for any spills located in Pinellas County, shall be provided to Pinellas County for informational purposes. Smaller ground surface spills shall be cleaned up as soon as practical (FDEP 2010a).

Building-related groundwater withdrawals from the Upper Floridan aquifer, although unlikely, have the potential to decrease water levels at the site and induce lateral saltwater intrusion from the CFBC and vertical migration of saline waters from deeper Floridan aquifer intervals. The impacts on groundwater quality during building activities are bounded by the impacts during operation of the LNP Units 1 and 2, as discussed in Section 5.2.3.2, because operational groundwater usage is greater than that during building activities. Therefore, the review team concludes that groundwater-quality impacts during building activities would be minor, and mitigation beyond the conditions of certification would not be warranted.

Based on the consideration of potential impact from dewatering, spills, and salt water intrusion; information provided by PEF; and the review team's independent evaluation, the review team concludes that the groundwater quality impacts at the site from construction and preconstruction activities would be SMALL, and no further mitigation, other than BMPs and the conditions of Florida Site Certification, would be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that groundwater-quality impacts of NRC-authorized construction activities would be SMALL.

4.2.4 Water Monitoring

Prior to initiating building activities, PEF would be required to develop a SWPPP (FDEP 2010a). During building activities for Units 1 and 2, the SWPPP would be in effect and may include a monitoring program.

Section 6.3 of the ER (PEF 2009a) describes the hydrologic monitoring program that would be used to control potential impacts on groundwater caused by site preparation and building activities and identifies alternatives or engineering measures that could be implemented to reduce potential adverse impacts. Most pre-application monitoring wells are located within the disturbance footprint and would need to be decommissioned prior to the start of building activities. Hydrologic measurements would continue to be collected in the four pre-application monitoring wells that would not be disturbed by building activities (MW-1S, MW-2S, MW-3S, and MW-4S). In addition, a hydrologic monitoring program during building activities would be implemented to monitor dewatering impacts at the two nuclear island excavations. This program would be designed to monitor head differential between the inside and outside of the diaphragm wall, as well as the uplift pressure on the bottom of the excavation (PEF 2009b).

Section 6.6 of the ER (PEF 2009a) describes the chemical monitoring program. The objective of pre-disturbance and preoperational monitoring is to characterize the chemical quality of groundwater at the site and provide a basis from which to identify the impacts resulting from building activities and plant operations. While the LNP is being built, groundwater chemistry would be monitored quarterly in the four pre-application monitoring wells mentioned above. Sampling and analysis requirements for these monitoring events would be the same as those specified for pre-application monitoring (PEF 2009a).

4.3 Ecological Impacts

This section describes the potential impacts on ecological resources resulting from development of proposed LNP Units 1 and 2 and associated offsite facilities, including transmission lines required to tie into the Florida electrical grid system. Impacts on terrestrial resources are presented in Section 4.3.1, and impacts on aquatic resources are addressed in Section 4.3.2.

4.3.1 Terrestrial and Wetland Impacts

This section evaluates impacts on terrestrial and wetland resources from site-preparation activities and build-out for the proposed LNP Units 1 and 2 and associated offsite facilities.

4.3.1.1 Terrestrial Resources – Site and Vicinity

Most terrestrial impacts would occur near the center of the 3105-ac LNP site where the two reactors and ancillary power production facilities would be built. Additional impacts would extend to the southeast corner of the site within a corridor supporting the heavy-haul road, the blowdown and makeup pipelines, and four 500-kV transmission lines. As described in Section 2.4.1, terrestrial habitats throughout the site have already been substantially altered by intensive commercial forest management over many decades. For the purposes of the following analysis (excluding transmission line impacts included as part of Section 4.3.2.2), all impacts that lie within the zone of disturbance indicated on proposed site-development plans (see Figure 3-1) are treated as permanent impacts. Temporary impacts are estimated to consist of clearing vegetation in a 50-ft buffer around the perimeter of the depicted development activities.

Cover Types (Habitats)

Development of LNP facilities would require permanent or temporary disturbance or removal of existing vegetation from approximately 776.6 ac (25 percent) of the LNP site. Impacts would result from clearing and grubbing, grading, excavation, and the placement of fill. Permanent and temporary impacts estimated by FLUCFCS cover type are presented in Table 4-4.

Table 4-4. Extent of Project Development-Related Impacts on Cover Types of the LNP Site

Cover Type (Habitat)	FLUCFCS Code[(a)]	Approximate Existing Area on LNP Site (Acres)	Permanent Impacts: Acres	Permanent Impacts: Percent of Total Site	Temporary Impacts: Acres	Temporary Impacts: Percent of Total Site
Coniferous plantations	441	962.9	277.5	8.9	56.6	1.8
Wet planted pine	629	812.7	135.0	4.3	39.5	1.3
Cypress	621	402.6	53.8	1.7	13.2	0.4
Mixed wetland hardwoods	617	317.6	10.2	0.3	2.7	0.1
Treeless hydric savanna	646	274.4	73.5	2.4	19.1	0.6
Wetland forested mixed	630	156.4	29.0	0.9	7.4	0.2
Other open lands (rural)	260	106	31.0	1.0	9.1	0.3
Freshwater marshes	641	23.5	12.0	0.4	0.6	>0.1
Hardwood conifer mixed	434	16	0	0	0	0
Wet prairie	643	14.3	5.1	0.2	1.5	>0.1
Upland coniferous forest	410	11	0.1	>0.1	0.1	>0.1
Utilities	830	4.0	0	0	0	0
Pine flatwoods	411	3.0	0	0	0	0
Shrub and brushland	320	0.6	0	0	0	0
Total		3105	627.0	20.2	149.6	4.8

Sources: PEF 2009c, e; FDOT 1999.
(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System.

Permanent losses would account for about 627.0 ac, with impacts on habitat that has been altered by commercial forest management accounting for the greatest losses. Approximately 277.5 ac of coniferous plantations (FLUCFCS 441) and 135.0 ac of wet planted pine (FLUCFCS 629) would be permanently lost; as well as 73.5 ac of treeless hydric savanna (FLUCFCS 646) and 31.0 ac of other open lands (rural) (FLUCFCS 260) (which have been recently clear-cut but not yet replanted with trees). Permanent impacts on natural cover types (those not substantially influenced by commercial forest management) would be greatest for cypress swamps (FLUCFCS 621; 53.8 ac), and wetland forested mixed (FLUCFCS 630; 29.0 ac). Permanent impacts to remaining natural cover types onsite would be minimal.

Temporary impacts would occur on about 149.6 ac of the site, primarily to cover types that have been altered by commercial forest management including coniferous plantations (FLUCFCS 441; 56.6 ac); wet planted pine (FLUCFCS 629; 39.5 ac); treeless hydric savanna (FLUCFCS 646; 19.1 ac); and other open lands (rural) (FLUCFCS 260; 9.1 ac) (Table 4-4). Temporary impacts on natural cover types onsite would be greatest for cypress (FLUCFCS 621; 13.5 ac) and wetland forested mixed cover (FLUCFCS 630; 7.4 ac). Impacts on other natural cover types would be relatively minor. Temporarily disturbed areas would be regraded to pre-existing contours after site-development activities have ceased. Uplands would be seeded in accordance with project-developed sedimentation and erosion-control plans, while wetlands would be allowed to regenerate naturally from the existing wetland seed bank (PEF 2009c, e). Refer to Section 4.3.1.7 for a description of the mitigation planning effort and the BMPs PEF proposes to use to restore temporarily disturbed lands.

In Table 4-5, estimated losses were compared to the availability of similar FLUCFCS cover types within a 6-mi radius of the LNP site to assess the extent of habitat losses to the overall occurrence of biotic communities in the project vicinity. The proposed permanent and temporary impacts would affect only cover types that are common in the project vicinity. Losses for each affected cover type would be relatively minor compared to overall occurrence in the project vicinity, with no impact on a cover type exceeding 4.9 percent of its availability in the project vicinity. The largest proportional impacts would occur to mixed wetland hardwoods forest (FLUCFCS 617; 4.9 percent) and coniferous plantations (2.6 percent as represented by the combined acreage of coniferous plantations and wet planted pine). For comparative purposes with the project vicinity, the acreage of wet planted pine (FLUCFCS 629) on the LNP site was combined with coniferous plantations (FLUCFCS 441) because this subcategory of pine plantation was not distinguished in the FLUCFCS land cover mapping for the project vicinity. Impact on treeless hydric savanna (FLUCFCS 646), represented on the LNP site by recently clear-cut forest stands on low-lying wetland flats not yet replanted to conifers, is not included with this project vicinity analysis. Very little natural treeless hydric savanna (which is also referred to as mixed scrub-shrub wetland) is identified from the FLUCFCS land cover mapping for the project vicinity.

Table 4-5. Extent of Project Development-Related Impacts on Cover Types in the LNP Vicinity

Cover Type (Habitat)	FLUCFCS Code[a]	Availability in Vicinity (ac)	Permanent LNP Site Impacts (ac)	Temporary LNP Site Impacts (ac)	Total Impact Relative to Availability in Vicinity (%)
Other open lands (rural)	260	5251.7	31.0	9.1	0.8
Upland coniferous forest	410	8187.9	0.1	0.1	>0.1
Coniferous plantations[b]	441&629	19,724.5	412.5[c]	96.1[c]	2.6
Mixed wetland hardwoods	617	262.8	10.2	2.7	4.9
Cypress	621	5331.5	53.8	13.2	1.3
Wetland forested mixed	630	5245.5	29.0	7.4	0.7
Freshwater marshes	641	2126.3	12.0	0.6	0.6
Wet prairies	643	313.0	5.1	1.5	2.1
Treeless hydric savanna[d]	646	92.5	73.5	19.1	n/a[d]
Other FLUCFCS cover types	n/a	39,285.3	0	0	0
Total		72,381.4	627.0	149.6	

Sources: PEF 2009f, FDOT 1999.
(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System.
(b) All tree plantations were assumed planted to pine and classified as coniferous plantations (FLUCFCS 441).
(c) Wet planted pine (FLUCFCS 629) identified for the LNP site was combined with coniferous plantations because this subcategory of tree plantations was not distinguished in the FLUCFCS land cover mapping for the project vicinity.
(d) Treeless hydric savanna (FLUCFCS 646) from the LNP site is not included in this analysis because this custom cover type is an artifact of logging practices on the site.
n/a = not applicable

The treeless hydric savanna classified during site-specific mapping of the LNP site is an artifact of forest-management activities.

Approximately 75 percent of the LNP site would remain undeveloped, providing a vegetated buffer around the centrally located LNP facilities. PEF's proposed wetland mitigation concept calls for ceasing commercial forest management over approximately 1549 ac of undeveloped areas remaining on the LNP site and part of a property owned by PEF directly south of the LNP site, followed by rehabilitating pine plantations and other disturbed habitats through a series of vegetation management and restorative processes to reestablish plant communities more functionally similar to native upland and wetland habitats (Entrix 2010). Restorative processes would include selective tree thinning, prescribed fire, and hydrologic restoration to achieve high ecological value. A more detailed description of the wetland mitigation planning effort is provided in Section 4.3.1.7. PEF has not indicated how it would manage the other remaining undeveloped land on the LNP site or PEF property to the south.

Wetlands

Impacts on wetlands from project development activities on the LNP site would include filling, erosion, sedimentation, alterations to hydrology, and clearing of vegetation. Wetlands located within and adjacent to the limits of site-preparation activities may be subject to three general types of impacts: 1) permanent fill impacts converting wetlands to developed uplands, where all wetland functions are lost indefinitely; (2) temporary disturbance impacts where some or all wetland functions are restored after site development is completed; and (3) partial impacts from the clearing of trees along final transmission-line rights-of-way where nonforested wetland functions would be retained. Impacts on wetlands were quantified by overlaying the site plan onto the wetland delineation for the LNP site and evaluating the likely changes to wetland functions. Review by the USACE and FDEP of wetland delineations performed by PEF's consultants is ongoing. Final approvals of the determination of the presence of jurisdictional waters, including the delineation of wetlands are expected from the USACE and FDEP by the end of 2010.

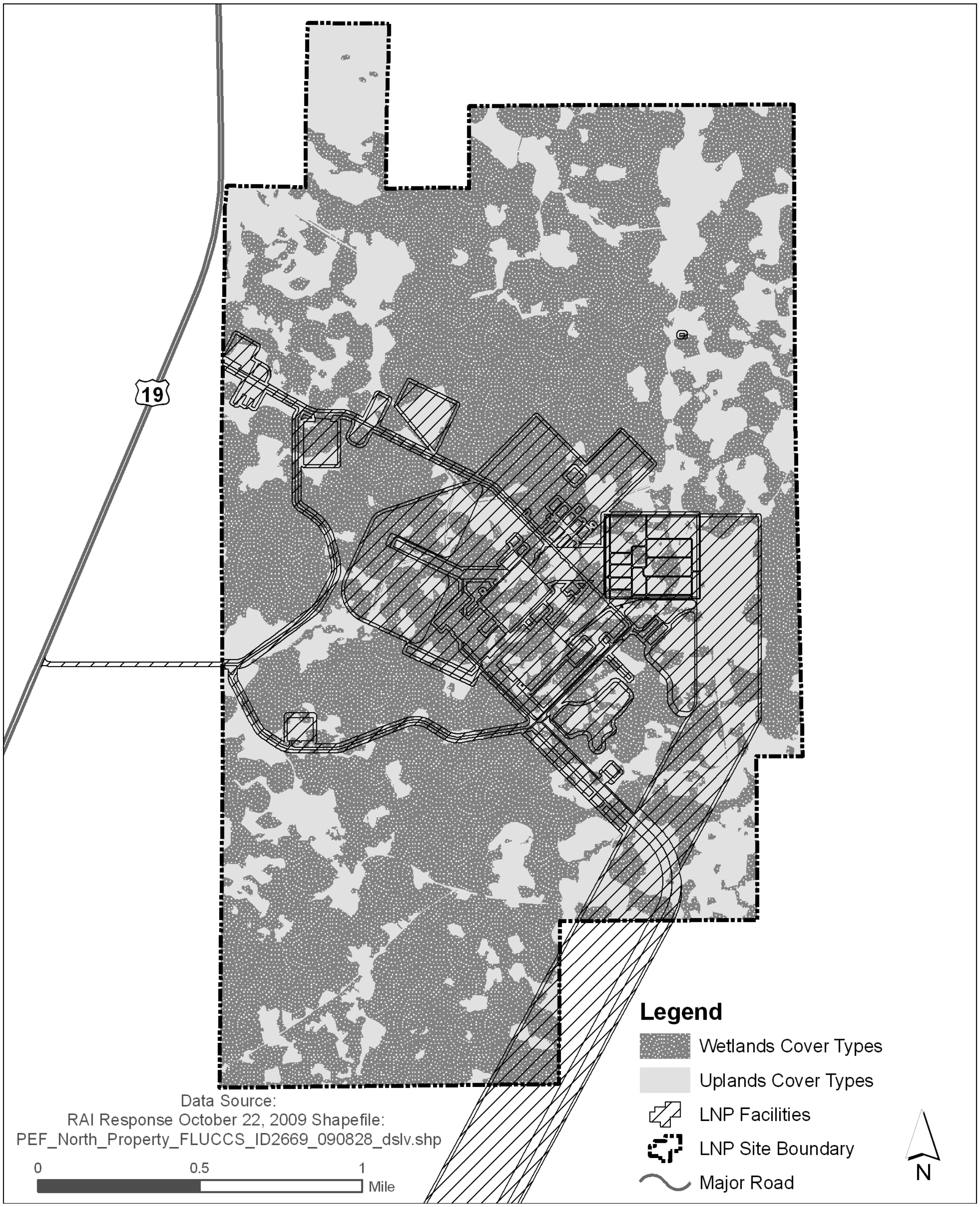
Wetlands make up about 64.5 percent (2001.5 ac) of the 3105-ac LNP site (Table 4-6). Although impacts on wetlands were avoided and minimized to the extent practicable during project design, wetland impacts during project development are unavoidable. This is a consequence of the large amount and broad distribution of wetlands present on the LNP site, as well as the numerous safety, operational, and engineering constraints required to site a nuclear facility. Approximately 318.6 ac of wetlands on the LNP site would be permanently filled, representing a permanent loss of approximately 15.9 percent of the total wetlands onsite (Table 4-6 and Figure 4-2). Of the wetland cover types on the site, the wet planted pine cover type (FLUCFCS 629) would sustain the greatest amount of permanent wetland impact (135 ac), followed by treeless hydric savanna (FLUCFCS 646) (73.5 ac). These wetlands have been historically degraded by commercial forest management, generally are of lower quality, and provide reduced functions relative to natural wetland cover types. However, permanent impacts on about 110 ac of higher-quality wetland systems would occur as well. Losses of native wetland cover types would include approximately 53.8 ac of cypress (FLUCFCS 621), 29.0 ac of wetland forested mixed (FLUCFCS 630), 10.2 ac of mixed wetland hardwoods (FLUCFCS 617), 12.0 ac of freshwater marsh (FLUCFCS 641), and 5.1 ac of wet prairie (FLUCFCS 643). Temporary impacts would affect about 84.0 ac of wetlands on the LNP site, with wet planted pine (39.5 ac) and treeless hydric savanna (19.1 ac) accounting for more than two-thirds of the temporary wetland impacts (Table 4-6). Natural wetlands affected would include about 23.3 ac of wetland swamps (i.e., cypress, wetland forested mixed, and mixed wetland hardwoods) and minor amounts of wet prairie and freshwater marshes. Wetlands subject to temporary impacts would be regraded to pre-existing contours after site development has ceased and allowed to

Table 4-6. Extent of Project Development Impacts to Wetlands on the LNP Site

Wetland Cover Type	FLUCFCS Code[(a)]	Existing Area (acres)	Permanent Impacts		Temporary Impacts	
			Acres	Percent of Total Site Wetlands	Acres	Percent of Total Site Wetlands
Wet planted pine	629	812.7	135.0	6.7	39.5	2.0
Cypress	621	402.6	53.8	2.7	13.2	0.7
Mixed wetland hardwoods	617	317.6	10.2	0.5	2.7	0.1
Treeless hydric savanna	646	274.4	73.5	3.7	19.1	1.0
Wetland forested mixed	630	156.4	29.0	1.4	7.4	0.4
Freshwater marshes	641	23.5	12.0	0.6	0.6	>0.1
Wet prairie	643	14.3	5.1	0.3	1.5	0.1
Total		2001.5	318.6	15.9	84.0	4.2

Sources: PEF 2009e, FDOT 1999.

(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System.



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2 **Figure 4-2**. Extent of Project Development-Related Impacts on Delineated Wetlands of the
3 LNP Site (PEF 2009n)

regenerate naturally from the existing wetland seed bank (PEF 2009c, e). Refer to Section 4.3.1.7 for a description of PEF's wetland mitigation planning effort, including BMPs to restore temporarily disturbed wetlands.

Temporary, localized dewatering impacts on wetlands could occur during excavation of the powerblocks for proposed LNP Units 1 and 2. Dewatering of the 75-ft deep foundation excavations would be required to build each proposed powerblock. While the foundation excavations may reach 75 feet, dewatering to support the foundation construction may go to 100 feet. Measures would be taken prior to excavation to isolate and seal the dewatering areas and minimize inflow into the excavations. An impervious reinforced diaphragm wall would be installed around the perimeter of each excavation, and the underlying bedrock would be sealed by drilling and pressure grouting (PEF 2009c). Over a roughly 2 to 4-year period (depending on the extent of overlap between building the powerblocks for LNP Units 1 and 2), inflow and stormwater from within the excavations would be intermittently pumped for each nuclear island and discharged to an infiltration basin sized for the estimated flow rate (PEF 2008a, 2009c, e).

These actions are expected to prevent significant drawdowns from occurring in the surficial aquifer system surrounding the excavations that supports hydrologically connected adjoining wetlands (PEF 2009c). No long-term changes to local groundwater levels are expected as a consequence of the dewatering (i.e., groundwater is expected to return to pre-disturbance levels after dewatering ceases).

Temporary, localized dewatering of wetlands would also be necessary to install the blowdown and makeup pipelines and some other facilities (PEF 2009c). Dewatering of wetlands traversed by the pipeline excavations would occur in a segmented manner, with excavation, pipe installation, and backfill occurring in short duration. Pumped water would be discharged to infiltration basins situated between the excavation and adjacent wetlands to create a groundwater mound that would minimize impact on wetlands. Because of the short duration of dewatering, the shallow depth of the excavations, and the groundwater recharge achieved through groundwater mounding, no long-term impact on wetlands are expected from pipeline installation. In deeper excavations, such as for the turbine building and the circulating-water system, pumped water would be discharged to infiltration basins to recharge adjacent wetlands. PEF has committed to monitoring adjacent surface and ground water levels to ensure that dewatering impacts are minimized. If any detrimental impact on water levels affecting adjacent wetlands were detected during monitoring, mitigative measures such as drilling and grouting, sheeting, or re-design of the recharge basins would be implemented (PEF 2009c).

Wetlands in the LNP vicinity are adapted to a range of seasonal and annual variability in groundwater levels, including periodic drought. Monitoring conducted by PEF documented that groundwater levels on the LNP site fluctuate by as much as 5 ft over the course of 1 year (March 2007 to March 2008), and long-term data from nearby wells suggest seasonal groundwater fluctuations of as much as 7 to 8 ft (see Section 2.3.1.2). Although dewatering may temporarily lower the water table supporting nearby wetlands, the effects would be short-lived (i.e., at most 2 to 4 years, depending on the extent of overlap between building the powerblocks for LNP Units 1 and 2) and within the range of variability to which these wetlands systems have adapted. Rainfall, which is abundant during summer months (see Section 2.9.1), would help limit any temporary stress trees and other wetland flora and fauna could experience during dewatering. Consequently, no long-term adverse impacts on adjacent wetlands would be expected from dewatering during site development. PEF would be required to prepare a dewatering plan for approval by the FDEP and SWFWMD. The plan would include details of the dewatering system, discharge quantities and location, a monitoring plan, and other details needed to demonstrate that it meets the State of Florida Conditions of Certification (FDEP 2010a) and complies with all applicable ERP dewatering requirements.

Authorization to affect wetlands on the LNP site would require a Clean Water Act Section 404 permit issued by the USACE and an ERP issued by the State of Florida. In Florida, the ERP application serves as a joint Federal/State permit application to affect wetlands. PEF submitted an ERP in June 2008 as part of the Site Certification Application, initiating the Section 404 and State permitting processes. PEF is required under the Federal and State permitting processes to avoid or minimize wetland impacts to the extent practicable and to mitigate for unavoidable wetland impacts. The Section 404 permit would also require a Clean Water Act Section 401 Water Quality Certification issued by the FDEP to control the discharge of water caused by site development activities.

Mitigation for unavoidable impacts on wetlands is required through both the Section 404 permitting process and the ERP process. PEF has prepared a wetland mitigation plan that would compensate for the loss or impairment of functions to wetlands affected by project activities, including wetland impacts on the LNP site and those for the associated offsite facilities (Entrix 2010). By using the Florida Uniform Mitigation Assessment Methodology (UMAM) – a wetland functional analysis method used by the FDEP and the USACE to evaluate wetland functions and estimate associated mitigation requirements – PEF determined the amount of mitigation required to adequately compensate for wetland impacts. PEF's determination would be independently verified by the USACE. Refer to Section 4.3.1.7 for a description of the wetland mitigation plan, including an account of the functional losses predicted to occur with site development and the functional gains to be incurred with implementation of the mitigation plan.

Wildlife

Whenever development removes or modifies large blocks of habitat, loss of wildlife is an unavoidable consequence. Although many of the wildlife habitats on the LNP site have been previously degraded by commercial forest management, the interspersion of pine plantations, wetlands, and mixed forestland on the site still provides sufficient water, food, and vegetative cover to support a variety of wildlife species. Clearing of vegetation and other site-preparation activities on the LNP site have the potential to adversely affect wildlife, either through direct mortality or by displacing wildlife into adjacent habitats where they must compete with other wildlife for finite resources. About 627 ac of wildlife habitat would be permanently removed, with another 149.6 ac temporarily disturbed (Table 4-4). Most of the impacts would involve lands previously altered by logging (i.e., pine plantations and other open lands), but about 116 ac (representing both permanent and temporary impacts) would involve less frequently disturbed forestlands that provide higher-quality habitat for wildlife. Wildlife species associated with these cover types and, therefore, subject to impacts are identified in Section 2.4.1.

During site preparation for the LNP site, wildlife would be killed or displaced primarily as a result of heavy equipment operation during land clearing. Less mobile animals, such as reptiles, amphibians, and small mammals, are expected to incur greater direct mortality than more mobile animals, such as birds and large mammals, which would be displaced to adjacent habitats. Land clearing done during the spring/early summer nesting period for most bird species could be detrimental to nesting and reproductive success. If this work were to be carried out during non-nesting periods for most species, impacts on nesting birds could be reduced.

About 75 percent (2328 ac) of the LNP site would not be physically disturbed during site development and could therefore receive displaced wildlife. Other wildlife habitats occur just outside of the perimeter of the site, including the Goethe State Forest to the north and northeast. Although these habitats could support displaced animals, increased competition for available space and resources may result in increased stress, greater susceptibility to predation, and a decline in reproductive success. Temporary wildlife population fluctuations would be expected in these habitats as competitive forces act to define new equilibrium population levels. Species that can adapt to disturbed or developed areas may readily re-colonize disturbed areas and temporarily disturbed areas after restoration.

As site development is completed, remaining habitats adjacent to disturbed areas would again become available for use by wildlife that previously occupied the affected areas. Under mitigation plans proposed for the LNP site, commercial timber management would cease on approximately 1549 ac of the remaining undisturbed lands on the LNP site, wherein pine plantations and other disturbed habitats would be rehabilitated and restored to native plant communities that provide better wildlife habitat (PEF 2009e; Entrix 2010). The higher-quality habitat provided by the restored communities would allow for an increase in wildlife diversity and species population levels. Perimeter fencing that could restrict movement by medium- and large-sized animals would be limited to areas close to plant facilities, as needed to provide security or industrial safety. Fencing would not be built around the LNP property line, thereby allowing unimpeded movement by wildlife between undeveloped areas on the site and adjacent offsite habitats (PEF 2009g). Mitigation beneficial to wildlife is discussed further under Section 4.3.1.7.

Habitat fragmentation is another factor that can adversely affect wildlife resources. Habitat fragmentation occurs when development divides and isolates blocks of otherwise suitable wildlife habitat. Fragmentation can effectively reduce the amount of habitat across the landscape that is available to wildlife species requiring large blocks of contiguous suitable habitat. Wildlife occupying the remaining smaller patches may be subject to increased predation, vulnerability, and insularity (i.e., separation from other populations), and may suffer a decrease in dispersal success. The net result can be a decline in the diversity and abundance of wildlife the landscape can support. The degree to which fragmentation affects wildlife depends upon the size and isolation of the parcels being fragmented as well as the sensitivity of the species present. For example, many neotropical migratory bird species are particularly vulnerable to habitat fragmentation. They winter in tropical climates and either migrate through or nest in the subtropical or more northerly latitudes. Neotropical migrants represented on the LNP site include various vireos, flycatchers, thrushes, tanagers, and warblers (see Appendix K).

The LNP site is already highly fragmented, a consequence of decades of commercial forest management that has simplified the landscape and modified wildlife habitat. Development activities would further fragment upland and wetland habitats used by wildlife. However, considering the already fragmented condition of the LNP site, the incremental impact of further fragmentation caused by site-preparation activities on wildlife and wildlife habitat is expected to be minimal. Restoration of approximately 1549 ac of undeveloped lands remaining on the LNP site and PEF-owned property directly to the south would help to mitigate the effects of fragmentation by creating a more contiguous native landscape on lands now highly altered by commercial forest management. For example, restoring native pine flatwood (FLUCFCS 411), cypress forest (FLUCFCS 621), and hardwood swamp (FLUCFCS 617 and 630) communities on the site would enhance the quality of nearby similar habitats in the Goethe State Forest.

Human activities and elevated noise levels during site-development activities may also adversely affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications and by disrupting communications required for breeding or defense (Larkin 1996). It is not unusual, however, for wildlife to habituate to noise and human presence. LNP site-development activities that would generate noise include the operation of equipment such as jack hammers, pile drivers, and heavy-construction vehicles. Noise would also result from the movement of workers, materials, and equipment. Background noise levels on and near the LNP site would increase during site development, but this would primarily be limited to daytime hours (PEF 2009a). Short-term noise levels onsite could be as high as 104 dBA as measured 50 ft from the source, but it would generally range between 70 and 90 dBA at 50 ft (PEF 2009a). Except during especially limited periods of intense activities (e.g., pile driving), offsite daytime noise levels would generally remain below 65 dBA (PEF 2009a). The threshold at which birds and red foxes (used here as a surrogate for small and medium-sized mammals) are startled or frightened is 80 to 85 dBA (Golden et al. 1980). The review team expects that noise levels associated with development activities on the LNP site would generally be below those threshold levels at about 400 ft. Thus, overall impacts on wildlife from noise during site development are expected to be minor, temporary, and limited to onsite habitats adjacent to active operations.

The erection of tall structures on the LNP site, such as cooling towers and transmission towers, and the presence of industrial cranes and other equipment pose a potential collision hazard for birds. Avian collisions are a consequence of numerous factors related to species characteristics such as flight behavior, age, habitat use, seasonal habits, and diurnal habits, as well as environmental characteristics such as weather, topography, land use, and orientation of structures. Most authors on the subject of avian collisions with utility structures agree that collisions are not a biologically significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). However, impacts on populations of less common bird species may be of greater biological concern. NRC (1996) reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that overall avian mortality is low. Considering these studies, avian collisions with structures and equipment during LNP site development represent a small hazard for resident bird populations. The relatively low (56-ft-high) mechanical draft cooling towers proposed for LNP Units 1 and 2 represent a low threat to bird mortality (PEF 2009a). Noise and human activity associated with site development should also discourage bird use of active development areas.

Bats are also documented to collide with building, towers and other tall structures (Erickson et al. 2002, Evans Ogden 1996). While bat mortality associated with wind energy turbines can be substantial, collision fatalities with other tall anthropogenic structures are rarely reported (Cryan and Barclay 2009). Few bat mortalities have been reported during monitoring for avian collisions at nuclear power plants with large cooling towers (NRC 1996)[(a)]. While bat collisions with structures and tall construction equipment at the LNP site are possible, it is not expected to be a significant source of direct mortality.

Migratory birds and their active nests are afforded protection under the Migratory Bird Treaty Act of 1918. A migratory bird is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. Presently, 836 bird species are protected by the Migratory Bird Treaty Act, 58 of which are currently legally hunted as game birds (FWS 2009d). Numerous migratory bird species are expected to use habitats on the LNP site for nesting, as a winter refuge, or as a stopover site during annual migrations. The LNP site is situated within a branch of the Eastern Atlantic Flyway that crosses the Florida peninsula (FWS 2010a; Birdnature.com 2009). Proposed activities on the LNP site have the potential to affect migratory birds. Migratory birds would be expected to flee land-clearing activities and avoid direct mortality. However, if vegetation clearing occurs during the nesting

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(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

season, nests and eggs of migratory birds could be destroyed. Migratory bird collisions with structures and tall construction equipment also are possible, but they likely would not be a significant source of direct mortality for nesting and winter residents. However, collisions with structures and equipment may be slightly higher for migrating birds that unexpectedly encounter these hazards.

Increased traffic due to site workers would likely increase traffic-related wildlife mortalities over the time that workers are driving to the site. The primary access route to the LNP site would be US-19, and the peak number of workers traveling to the site would occur in 2014. If the proposed LNP project does not take place, PEF (2009a) estimates the peak traffic rate on US-19 to be 8923 daily trips in 2014. Traffic on US-19 approaching the LNP site from the north is projected to increase 15.9 percent (an additional 1418 daily trips) in 2014, with traffic approaching from the south increasing 37.1 percent (to 12,230 daily trips) in 2014 (PEF 2009a). US-19 is a large, busy highway that currently poses a significant hazard to wildlife attempting to cross it. Traffic from the LNP project would contribute to an incremental increase in traffic-related wildlife mortalities. If road-kill rates were to exceed the rates of reproduction and immigration, local wildlife populations could suffer declines. While road kills are an obvious source of wildlife mortality, traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall effect on local wildlife populations from increased vehicular traffic associated with LNP site development is expected to be minimal.

4.3.1.2 Terrestrial Resources – Associated Offsite Facilities

This section assesses impacts on terrestrial resources expected to occur with development of the associated offsite facilities including the heavy-haul road; barge slip and barge slip access road; and makeup-water and blowdown-water pipelines including associated cooling-water intake and discharge and transmission lines (Golder Associates 2008; CH2M HILL 2009a) needed to deliver the power generated by LNP into the Florida electrical grid system. For the purposes of this analysis, all impacts that lie within the zone of disturbance (i.e., the development footprint) are treated as permanent impacts. Temporary impacts are represented by a 50 foot buffer adjacent to the pipeline corridor and heavy haul road between the LNP site and the CFBC. All impacts associated with the transmission lines are treated as permanent impacts.

The locations where associated facilities would be sited are known for all facilities except the transmission lines and their substations. In compliance with the PPSA, PEF (2008a, 2009a) has identified corridors (300 ft to 1 mi wide) within which the transmission lines and their substations would be sited. More than 90 percent of the new transmission lines would be collocated with existing PEF transmission lines (PEF 2009e). PEF expects to acquire 220-ft-wide rights-of-way for the proposed 500-kV transmission lines and 100-ft-wide rights-of-way for the proposed 230-kV transmission lines (Golder Associates 2008). Once the final rights-of-way have been selected and approved by the State, FDEP would require PEF to complete more detailed terrestrial ecology surveys along the rights-of-ways so that unavoidable impacts from development of the transmission lines can be fully accounted for and mitigated (FDEP 2009a).

PEF petitioned the State of Florida on April 29, 2010 for a modification to the currently certified corridor for the heavy-haul road, cooling-water makeup pipelines and the blowdown pipelines to be constructed between the LNP site and the CREC (Figure 3-7) (PEF 2010b). The purpose of the modification is to provide more flexibility in minimizing impacts on wetlands and other natural resources when siting these facilities, to reduce the use of State-owned lands along the CFBC, and to minimize disruption of recreational activities along the CFBC. Final right-of-way widths for each facility to be located within the corridor would remain the same.

The following evaluation of potential impacts on cover types, wetlands, and wildlife is conducted subject to the above limitations. Impacts from the transmission lines are discussed in a generic manner because final rights-of-ways have not been established. Unless specifically noted, no distinction is made between transmission-line impacts up to the first substations and impacts extending beyond the first substations.

Cover Types (Habitats) and Wetlands

As land is cleared, graded, excavated, and filled to build the facilities, permanent and temporary impacts on vegetative communities, including wetlands, would result. Impacts for associated facilities, excluding the transmission lines (i.e., the heavy-haul road, barge slip and barge slip access road, the makeup-water and blowdown-water pipelines, and other miscellaneous impacts), are summarized in Table 4-7. Permanent losses would total about 219 ac, with the most losses incurred by upland communities such as coniferous plantations (FLUCFCS 441; 66.8 ac); open land (FLUCFCS 190; 39.8 ac), which represents undeveloped land within urban areas; and mixed hardwood/conifer forest (FLUCFCS 434; 18.9 ac). Permanent wetland losses (all due to fill) would account for about 31.9 ac, as represented by the 600 series FLUCFCS cover types noted in Table 4-7. Most wetland losses would involve areas of cypress swamps (FLUCFCS 621; 12.5 ac) and freshwater marshes (FLUCFCS 641; 12.5 ac). These wetland impacts were estimated using FLUCFCS cover type mapping and would be revised once wetland delineations have been completed in these areas and jurisdictional determinations are reached by the USACE and FDEP.

Temporary impacts for associated facilities, excluding the transmission lines, would affect another 29.6 ac of vegetation cover types within a 50-ft buffer adjacent to the heavy-haul road and makeup-water and blowdown pipelines (Table 4-7). This 50-ft buffer may be affected by activities such as the temporary placement of materials and a roadway (PEF 2009c). Most temporary impacts would involve cover types previously altered by land-management activities, including coniferous plantations (FLUCFCS 441; 11.8 ac) and other open lands (rural) (FLUCFCS 260; 8.4 ac), which represent unclassified agricultural land. Temporary wetland impacts would total 6.0 ac, with small impacts occurring on cypress (FLUCFCS 621), freshwater

Table 4-7. Extent of Development-Related Impacts on Cover Types for the Associated Offsite Facilities[a]

Cover Type	FLUCFCS Code[b]	Associated Facilities Excluding Transmission Lines (ac)		Transmission Lines up to First Substation (ac)	Transmission Lines Beyond First Substation (ac)	Total Impacts	
		Permanent	Temporary[c]	Permanent[d]	Permanent[d]	Permanent	Temporary[c,d]
Extractive	160	4.5	0	0	0	4.5	0
Open land	190	39.8	0	0	0	39.8	0
Other open lands (rural)	260	15	8.4	0	0	15	8.4
Shrub and brushland	320	0.9	0	0	0	0.9	0
Mixed rangeland	330	9.4	0	0	0	9.4	0
Upland coniferous forest	410	5.7	1.6	0	0	5.7	1.6
Pine flatwoods	411	3.8	0	26.8	3.4	34	0
Longleaf pine – xeric oak	412	0.7	0	178.6	7.4	186.7	0
Sand pine[e]	413	0	0	54.2	1.3	55.5	0
Xeric oak[e]	421	0	0	97.4	0.3	97.7	0
Melaleuca	424	0	0		0.3	0.3	0
Live oak[e]	427	0	0	11.3		11.3	0
Hardwood conifer mixed	434	18.9	1.8	515.5	31.9	566.3	1.8
Coniferous plantations[f]	441	66.8	11.8	245.8	1.1	313.7	11.8
Streams and waterways	510	1.7		1.5	0.6	3.8	0
Lakes	520	0	0	0.9	0.9	1.8	0
Reservoirs	530	2.4		0.3	6.3	9	0
Reservoirs < 10 ac	534	0	0	0	0.4	0.4	0

Table 4-7. (contd)

Cover Type	FLUCFCS Code[(b)]	Associated Facilities Excluding Transmission Lines (ac)		Transmission Lines up to First Substation (ac)	Transmission Lines Beyond First Substation (ac)	Total Impacts	
		Permanent	Temporary[(c)]	Permanent[(d)]	Permanent[(d)]	Permanent	Temporary[(c,d)]
Stream and lake swamps (bottomland)	615	0	0	38.6	3.4	42	0
Cypress	621	12.5	3.8	189.3	2.4	204.2	3.8
Cypress – pine – cabbage palm[(e)]	624	0	0	2.6	0	2.6	0
Wetland forested mixed	630	2.4	0.8	26.7	3.8	32.9	0.8
Wetland scrub	631	0	0	0	0.1	0.1	0
Freshwater marshes	641	12.5	1.4	25.9	33.5	71.9	1.4
Saltwater marshes	642	4.5	0	0	0	4.5	0
Wet prairies	643	0	0	4.5	0.9	5.4	0
Transportation	810	3	0	0	0	3	0
Utilities	830	14.8	0	89.8	180.5	285.1	0
Total		219.3	29.6	1509.7	278.5	2007.5	29.6

Sources: PEF 2009c, f; CH2M HILL 2008; FDOT 1999 (Source for barge slip impacts added to Column 3).

(a) Associated offsite facilities include the heavy-haul road, makeup-water and blowdown pipeline, barge slip and barge slip access road, site access roads, miscellaneous pipeline, and transmission lines.

(b) FLUCFCS = Florida Land Use, Cover and Forms Classification System.

(c) Temporary impacts are represented by a 50-ft buffer adjacent to the pipeline corridor and heavy-haul road between the LNP site and the CFBC.

(d) Temporary impacts associated with the transmission lines are treated as permanent impacts.

(e) This cover type was not identified from Water Management District FLUCFCS maps as being present in the Associated Facilities Corridors (note absence from Table 2-7). However, site inspections conducted by PEF to evaluate preliminary routing impacts for the transmission lines identified the presence of and the potential for impact on this cover type.

(f) All tree plantations were assumed planted to pine and classified as coniferous plantations (FLUCFCS 441).

marshes (FLUCFCS 641), and wetland forested mixed cover types (FLUCFCS 630). Temporarily disturbed sites would be regraded to pre-existing contours after development activities have ceased. Uplands would be seeded in accordance with project-developed sedimentation and erosion control plans, while wetlands would be allowed to regenerate naturally from the existing wetland seed bank (PEF 2009c, e). Refer to Section 4.3.1.7 for a description of the mitigation-planning effort and PEF's proposed BMPs to restore temporarily disturbed lands.

The amount of impact on vegetation cover types and wetlands is roughly estimated to be 1509.7 ac for transmission lines up to the first substation and 278.5 ac for transmission lines beyond the first substation (Table 4-7). These estimates were derived using preliminary rights-of-way locations for the proposed transmission lines within the identified corridors (PEF 2009c; Golder Associates 2008). For purposes of this analysis and to provide a conservative estimate of mitigation needs, all impacts associated with transmission-line development were assumed to be permanent (i.e., temporary impacts were treated as permanent impacts).

Impacts on cover types and wetlands for transmission lines beyond the first substation are much less than those estimated for transmission lines up to the first substation because most of these lines would be co-located within existing rights-of-way that already have been cleared (PEF 2009h).

Under the PPSA, the final impacts resulting from transmission-line development would be determined through a post-certification process after the final rights-of-way have been selected and approved by the State. To comply with USACE and FDEP regulatory requirements, PEF is obliged to minimize impacts on wetlands and waterbodies while siting final transmission-line rights-of-way and during development of the lines. Transmission-line activities generally would entail erosion control, corridor clearing and site preparation, placement of foundations, assembly and erection of structures, and installation of conductors. Clearing of vegetation from the selected rights-of-way would account for most of the terrestrial and wetland impacts. Because the selected rights-of-way would be narrow (100 to 220 ft wide) and co-located with existing transmission lines over about 90 percent of their distance (PEF 2009e; Golder Associates 2008), the required clearing would be greatly minimized. Wherever existing corridor widths are insufficient for the proposed transmission lines, additional clearing would be necessary. Based upon cover type mapping for the identified transmission-line corridors, the most affected upland cover types would be hardwood conifer mixed (FLUCFCS 434, 547.4 ac), coniferous plantations (FLUCFCS 441, 246.9 ac), and longleaf pine-xeric oak forest (FLUCFCS 412, 186.0 ac). Cypress swamp (FLUCFCS 621, 191.7 ac) would be the most affected wetland cover type (Table 4-7). Based upon the preliminary rights-of-way locations for the proposed transmission lines, total wetland losses could reach about 331.7 ac, as represented by the 600 series FLUCFCS cover types noted in Table 4-7.

Clearing of vegetation for final transmission-line rights-of-way would be dependent upon pre-existing site conditions, environmental constraints, and line design requirements. As summarized by PEF (2009a) and Golder Associates (2008), vegetation in uplands would be cleared to ground level. Stumps would be treated with an approved herbicide or grubbed to 6 in. below grade. Cut vegetation would be mulched or chipped onsite or piled and burned in compliance with local fire regulations. Vegetation in wetlands would be partially cleared using restrictive techniques, with the expectation that the cleared wetlands would be maintained in an herbaceous state. Wetland vegetation would be cleared by hand using chain saws or low ground pressure shear or rotary machines to reduce soil compaction and minimize damage to retained vegetation. Trees and vegetative growth with a mature height greater than 12 ft would be removed from the final rights-of-way. Other wetland vegetation (outside of access road and structure pad areas) would be left in place. Removed trees would be cut as low as possible and treated with an approved herbicide. Debris would be removed from wetlands using either low ground pressure equipment or temporary wetland construction mats and disposed of in upland areas.

Clearing for the final transmission-line rights-of-ways would constitute only a partial loss of wetland function because, although trees and tall vegetation would be removed, nonforested wetland functions would be maintained. However, some wetlands may have to be filled to install access roads and build structure pads. PEF is obligated under USACE and FDEP regulatory requirements to site roads and pads in ways that avoid or minimize wetland impacts, to the extent practicable. Because transmission lines would be co-located with existing transmission lines over about 90 percent of their distance, many opportunities exist to use existing access roads and pad sites. Pursuant to the PPSA, FDEP (2010a) would require an accounting of any unavoidable impacts on wetlands under a post-certification process.

Mitigation for unavoidable impacts on wetlands is required through both the Section 404 permit process and the ERP process. As previously noted, PEF has prepared a wetland mitigation plan to compensate for the loss or impairment of wetland functions, including those resulting from the associated offsite facilities (Entrix 2010). This plan includes an assessment of potential wetland impacts and UMAM functional losses based upon preliminary rights-of-way for the transmission lines within the identified corridors (Golder Associates 2008). Refer to Section 4.3.1.7 for a description of the wetland mitigation plan, including an account of the functional losses predicted to occur and the functional gains to be incurred with implementation of the mitigation plan.

In-stream activities proposed under the LNP project would mainly be associated with the CFBC (e.g., building the intake system or blowdown pipeline crossing and connection of the barge slip to the CFBC). Prior to conducting any in-stream activities, a Clean Water Act Section 10 permit under the Rivers and Harbors Act would be required. In-stream activities are addressed in Section 4.3.2.

Wildlife

Wildlife present on and around the associated facilities would be subjected to many of the same impacts described for the LNP site. Some wildlife would perish or be displaced during clearing, and, as a consequence of habitat loss, fragmentation and competition for remaining resources could occur. Less mobile animals, such as reptiles, amphibians, and small mammals, would incur greater mortality than more mobile animals, such as birds which would be displaced to adjacent communities. Land clearing done during the spring and/or early summer nesting period would be more detrimental to avian reproductive success than clearing conducted during non-nesting periods. Adjacent undisturbed habitats could support some displaced wildlife, but increased competition for available space and resources could depress population levels.

Wildlife habitat affected (permanent and temporary) to develop the associated facilities is estimated at 2037.1 ac (Table 4-7). Refer to the discussion presented under Cover Types and Wetlands (above) for a description of how these losses were calculated and apportioned for the associated facilities excluding the transmission lines, transmission lines up to the first substation, and transmission lines beyond the first substation. The co-location of the transmission lines with existing lines over about 90 percent of their distance (PEF 2009e; Golder Associates 2008) would greatly reduce potential impacts on wildlife and their habitat. Based upon cover type mapping, affected habitats would include upland and wetland forests that may provide high value habitat for wildlife, including approximately 568.1 ac of hardwood conifer mixed (FLUCFCS 434); 208 ac of cypress (FLUCFCS 621); 186.7 ac of longleaf pine-xeric oak (FLUCFCS 412); 97.7 ac of xeric oak (FLUCFCS 421); 55.5 ac of sand pine (FLUCFCS 413); and 73.3 ac of freshwater marshes (FLUCFCS 641). However, much of the affected habitats have lower wildlife value, including approximately 325.5 ac of coniferous plantations (FLUCFCS 441) and 285.1 ac of existing utility land (FLUCFCS 830), mostly existing transmission-line right-of-way. Actual losses of wildlife habitat would be determined upon final selection of the transmission-line rights-of-way, as a post-certification condition pursuant to the PPSA (FDEP 2010a).

Creation of new transmission-line corridors could be beneficial for wildlife species that occupy early successional habitat or benefit from increased habitat edge (i.e., forest/clearing interface environments). Species, such as white-tailed deer (*Odocoileus virginianus*), eastern cottontail rabbit (*Sylvilagus floridanus*), northern bobwhite (*Colinus virginianus*), northern cardinal (*Cardinalis cardinalis*), eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*), could exploit new corridors as groundcover redevelops. Raptors such as red-tailed hawks (*Buteo jamaicensis*) and great horned owls (*Bubo virginianus*) would likely hunt the corridors. Forested wetlands within the corridors would be converted to and maintained in an herbaceous or scrub-shrub condition. These wetlands may provide foraging habitat for wading birds. However, species dependent on forest habitats or sensitive to forest fragmentation could decline or be displaced, such as the Florida black bear (*Ursus americanus* *floridanus*), cavity-nesting birds (e.g., woodpeckers), and numerous birds that nest and feed in the crowns of trees (e.g., nuthatches and warblers).

Wildlife would also be affected by equipment noise and traffic, and birds could be injured if they collide with new transmission towers and conductors or the equipment used to install these components. Noise levels associated with installation of the transmission lines would be brief and intermittently spaced and would occur mostly during daylight hours (PEF 2008a). Installation of the transmission lines is expected to take only about 4 weeks per mile. Thus, the impact on wildlife from noise is expected to be temporary and minor. The potential for traffic-related wildlife mortality is also expected to be low because relatively small crews (compared to LNP site development) would spend only a limited time in each area as they progress over large geographic areas. Avian mortality resulting from collisions with structures and equipment during transmission-line installation would represent a small hazard for bird populations. Over 90 percent of the new transmission lines would be collocated with existing PEF transmission lines, which would reduce the potential for collisions by limiting how frequently birds need to cross rights-of-way (PEF 2009e). As a Condition of Certification, the FDEP (2010a) would require PEF to coordinate with the FFWCC in the development of an Avian Protection Plan for the transmission lines that would include measures to reduce potential collision impacts by birds. The Avian Protection Plan is discussed in more detail in Section 4.3.1.7 and Section 5.3.1.2.

4.3.1.3 Impacts on Important Terrestrial Species and Habitats

This section describes potential impacts on important terrestrial species, as defined by NRC in NUREG-1555 (NRC 2000) (see Section 2.4.1.3), resulting from development activities on the LNP site and associated offsite facilities, including transmission lines. Unless specifically noted, no distinction is made between transmission-line impacts up to the first substations and impacts extending beyond the first substations. To meet responsibilities under Section 7 of the Endangered Species Act of 1973, as amended (ESA), the review team has prepared a biological assessment that documents potential project impacts on Federally listed threatened or endangered terrestrial species. The biological assessment is provided in Appendix F.

Federally Listed Terrestrial Species

Federally listed terrestrial species that may occur on or in the vicinity of the LNP site and associated offsite facilities are noted in Table 2-8. No designated or proposed critical habitat for Federally listed terrestrial species occurs in counties containing the LNP site or the corridors for the associated offsite facilities. The potential impacts of development activities on these Federally listed species are described below.

Eastern Indigo Snake – Threatened

LNP Site

Eastern indigo snakes (*Drymarchon corais*) in Florida occupy a variety of habitats ranging from scrub and sandhill habitats to moister communities such as wet prairies and swamps (FNAI 2009). The species often seeks shelter during winter in gopher tortoise burrows, especially in northern Florida where temperatures are cooler. No eastern indigo snakes were observed on the LNP site during pedestrian surveys conducted over a 2-year period (PEF 2009a). However, the species has been documented in the site vicinity (PEF 2008a; FFWCC 2009). Most of the upland habitat on the LNP site has been converted to pine plantation and provides poor-quality habitat for eastern indigo snakes. Potentially suitable, though highly fragmented, forested wetland habitat is scattered throughout the site. Gopher tortoise burrows are present in the southeastern portion of the site (PEF 2009a). These factors suggest a potential for eastern indigo snakes to occur on the LNP site. However, their presence is likely limited due to highly fragmented habitat conditions and the dominance of pine plantations across the landscape.

Proposed development activities on the LNP site have the potential to affect the eastern indigo snake and its habitat. Because this species is not readily observed, its presence and extent of site use cannot be confirmed. Although the potential for impact on this species is thought to be low, incidental mortality to eastern indigo snakes is a possibility. During site development, FWS (2004) *Standard Protection Measures for the Eastern Indigo Snake* would be implemented to minimize impacts. A condition of certification by the FDEP would require surveys for and relocation of any gopher tortoises that could be harmed during “clearing and construction” at the LNP site (FDEP 2010a). Any eastern indigo snakes recovered during gopher tortoise burrow excavations would also be relocated in accordance with applicable guidelines. Under mitigation plans proposed for the LNP site, intensive commercial forest management would cease on most remaining undisturbed lands, and pine plantations and other disturbed habitats would be rehabilitated and restored to native plant communities (see Section 4.3.1.7). The restored communities would likely provide higher-quality habitat for eastern indigo snakes than the existing pine plantations and other vegetation altered by recent logging.

Associated Offsite Facilities

The eastern indigo snake is listed as potentially occurring in all counties through which the proposed corridors pass (FWS 2009a, b). Potentially suitable habitats and areas with prevalent gopher tortoise burrows are present along portions of the corridors, and one eastern indigo snake was observed in Sumter County during limited reconnaissance surveys conducted in the corridors (PEF 2008a). Therefore, activities in the associated corridors have the potential to affect the eastern indigo snake and its habitat. Because this species cannot be readily observed, its presence and extent of use within corridors cannot be readily confirmed.

As noted for the site, FWS *Standard Protection Measures for the Eastern Indigo Snake* would be implemented during development to minimize impacts. These measures require that clearing activities temporarily cease when eastern indigo snakes are observed, to provide time to escape. The likelihood that undetected individuals could escape disturbance is high because final rights-of-way would be narrow (100 to 220 ft wide) and collocated with existing corridors over most of their range, limiting the actual extent of required clearing. A condition of certification by the FDEP would require surveys for and relocation of any gopher tortoises that could be harmed during "clearing and construction" of offsite facilities (FDEP 2010a). Any eastern indigo snakes recovered during gopher tortoise burrow excavations would be relocated in accordance with applicable guidelines.

Sand Skink – Threatened

<u>LNP Site</u>

The sand skink (*Neoseps reynoldsi*) is a short, nearly legless lizard that principally occurs in rosemary scrub, but it also inhabits sand pine and oak scrub, scrubby flatwoods, turkey oak ridges within scrub, and edges of citrus groves occupying former scrub (FNAI 2009). It requires loose sand for burrowing in areas with large patches of sparse to no groundcover or tree canopy. The sand skink is not identified as potentially occurring in Levy County (FWS 2009a; FNAI 2009), and the sandy scrub habitats it prefers do not occur on the LNP site. No sand skinks were observed on the LNP site during pedestrian surveys conducted over a 2-year period (PEF 2009a). Therefore, it is unlikely that sand skinks would be affected by activities on the LNP site.

<u>Associated Offsite Facilities</u>

The sand skink is identified as potentially occurring in Marion, Lake, and Polk counties through which the proposed corridors pass (FWS 2009a, b; FNAI 2009). No sand skinks were observed during limited reconnaissance surveys conducted for wildlife within the corridors. However, preferred scrub habitats, although not prevalent, are present along portions of the corridors (PEF 2008a). Activities on the corridors therefore have the potential to affect the sand skink and its habitat. Because final rights-of-way would be narrow (100 to 220 ft wide) and mostly collocated with existing corridors, the actual extent of required clearing is greatly limited, thereby reducing the potential for impacts. A condition of certification by the FDEP would require surveys for sand skink prior to clearing finalized rights-of-way (FDEP 2010a). If sand skinks were identified and impacts could not be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

American Alligator – Threatened by Similarity of Appearance

LNP Site

The American alligator (*Alligator mississippiensis*) is listed by the FWS as threatened due to its similarity in appearance to the endangered American crocodile (*Crododylus acutus*). The LNP site is not located within the range of the crocodile, which is limited to coastal estuarine marshes and tidal swamps in south Florida. Consequently, no impacts on the American crocodile would be possible. Alligators are common in almost all permanent bodies of freshwater throughout Florida, including marshes, swamps, lakes, and ditches (FNAI 2009). One juvenile alligator was observed on the LNP site during field surveys conducted by PEF (2009a), and alligators may occasionally occur wherever permanent water is present. Habitat suitability for many onsite wetlands and swamps is low for the alligator because these wetlands are subject to seasonal drying. Nevertheless, potentially suitable wetlands and swamps would be filled, and activities in and around wetlands may temporarily disturb and displace alligators. Because alligators adapt easily to different aquatic and wetland habitats, individuals would likely relocate to adjacent areas with suitable habitat. Because the surrounding landscape is rural, movement of alligators into urban and suburban areas where they could pose a nuisance or danger is not likely. Impact on the American alligator from activities on the LNP site is therefore expected to be minor.

Associated Offsite Facilities

The American alligator is widespread in all counties through which the corridors pass (FNAI 2009). None of the counties lies within the range of the endangered American crocodile. Some wetlands and swamps that may support alligators would be filled, but most affected habitats would only experience overstory vegetation removal, retaining the open water component required by alligators. Higher-quality lake and stream habitats would generally be spanned by transmission lines, avoiding any impact on alligator habitat. Activities in and around wetlands could temporarily disturb and displace alligators. Because alligators adapt easily to different aquatic and wetland habitats, individuals would likely relocate to adjoining natural areas with suitable habitat. Because the surrounding landscape is generally rural, movement of alligators into urban and suburban areas where they could pose a nuisance or danger is not likely to occur. Impact on the American alligator is therefore expected to be minor.

Wood Stork – Endangered

LNP Site

Wood storks (*Mycteria americana*) nest in a variety of inundated forested wetlands and forage in shallow open waters wherever prey is concentrated (FNAI 2009). Individuals have been occasionally observed feeding in ditches and wetlands on the LNP site, but no nesting colonies (rookeries) are present (PEF 2009a). Wood storks have been observed roosting with other wading birds in forest stands 8 to 9 mi west of the LNP site (Entrix 2009). Long-term forest management on the LNP site and a lack of favored open water habitat limit suitable rookery habitat. The LNP site is not located within the core foraging area of any active wood stork rookery (FWS 2009c). Activities on the LNP site could remove or alter potential foraging habitat for the wood stork, and birds foraging onsite could be disturbed or displaced. Because wood storks are highly mobile and similar habitats are abundant in the project vicinity, it is unlikely that the species would be directly affected. Impact on the wood stork from activities on the LNP site is therefore expected to be minor.

Associated Offsite Facilities

The wood stork is listed as potentially occurring in all counties through which the associated facilities corridors would pass (FWS 2009a, b). No wood stork rookeries were observed during limited reconnaissance surveys within these corridors. However, individuals were observed on the 230-kV Polk-Hillsborough-Pinellas transmission-line corridor, and areas of potentially suitable habitat (forested wetlands, shallow emergent wetlands, and ditches) occur throughout portions of all corridors (PEF 2008a). In addition, the proposed corridors pass within the core foraging area of a number of active wood stork rookeries (FWS 2009c). Activities on the associated corridors have the potential to affect foraging and nesting habitat for the wood stork. Because final rights-of-way would be narrow (100 to 220 ft wide) and collocated with existing corridors over most of their range, the actual extent of clearing required to site-associated facilities is greatly limited, reducing the potential for impact on wood storks. A condition of certification by the FDEP would require surveys for wood storks and their rookeries prior to "clearing and construction" within finalized rights-of-way (FDEP 2010a). If wood stork foraging and nesting areas are identified and impacts cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

Red-Cockaded Woodpecker – Endangered

LNP Site

In northern and central Florida, the red-cockaded woodpecker (*Picoides borealis*) favors mature longleaf pine forests for nesting and foraging. The young (<30-years-old), heavily managed pine plantations on the LNP site do not provide favorable habitat. No red-cockaded woodpeckers were observed on the LNP site during pedestrian surveys conducted over a 2-year period (PEF 2009a, e). The species does, however, occur on the Goethe State Forest, located immediately north and northeast of the LNP site. Several active clusters (an aggregation of cavity trees used by a family group of red-cockaded woodpeckers) lie between 1.5 and 2.5 mi from the LNP site boundary (Petersen 2010). Considering the size of red cockaded woodpecker home ranges (100-400 ac; FWS 2003), the distance of these active clusters from the LNP site, and the lack of suitable habitat onsite, no more that incidental use of

LNP site would be expected by red cockaded woodpeckers. Consequently, it is unlikely red-cockaded woodpeckers would be affected by activities on the LNP site. A condition of certification by the FDEP would require protocol surveys for red-cockaded woodpeckers prior to "clearing and construction" on the LNP site (FDEP 2010a). If red-cockaded woodpeckers were detected and impacts could not be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

<u>Associated Offsite Facilities</u>

The red-cockaded woodpecker is listed as potentially occurring in all counties through which the corridors pass (FWS 2009a, b). Based upon FLUCFCS cover type mapping, areas of potentially suitable habitat for red-cockaded woodpeckers (e.g., FLUCFCS 411, 412) may occur within the corridors (PEF 2008a). Populations are known from the Withlacoochee State Forest, through which certain transmission line corridors would pass. Because reconnaissance surveys for wildlife have been limited, it is possible that red-cockaded woodpeckers could occur on or near the corridors.

Activities in the corridors therefore have the potential to affect the red-cockaded woodpecker and its habitat. Because final rights-of-way would be narrow (100 to 220 ft wide) and mostly collocated with existing corridors, the actual extent of clearing would be greatly limited, thereby minimizing the potential for impact on red-cockaded woodpeckers. A condition of certification by the FDEP would require protocol surveys for red-cockaded woodpeckers prior to "clearing and construction" in finalized rights-of-way (FDEP 2010a). If red-cockaded woodpeckers are detected and impacts cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

Florida Scrub Jay – Threatened

<u>LNP Site</u>

The Florida scrub jay (*Aphelocoma coerulescens*) favors fire-dominated, low-growing oak scrub habitat on well-drained sandy soils (FNAI 2009). This habitat generally corresponds with FLUCFCS 413 (sand pine) and FLUCFCS 421 (xeric oak). Populations may persist in areas with sparser oaks or overgrown scrub, but at lower densities. Although scrub jays have been documented in the vicinity (PEF 2008a; FFWCC 2009), no scrub jays were observed on the LNP site during pedestrian surveys conducted over a 2-year period (PEF 2009a). The xeric, well-drained scrub habitats preferred by scrub jays are lacking on the site. The conversion of most upland habitats to pine plantations where oaks and other hardwoods are discouraged has removed suitable habitat for this species and reduced the likelihood of its occurrence onsite. It is therefore unlikely that Florida scrub jays would be affected by development activities on the LNP site.

A condition of certification by the FDEP would require protocol surveys for the Florida scrub jay prior to "clearing and construction" on the LNP site (FDEP 2010a). If scrub jays are detected and impacts cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

Associated Offsite Facilities

The Florida scrub jay is listed as potentially occurring in all counties through which the corridors pass (FWS 2009a, b; FNAI 2009). Based upon FLUCFCS cover type mapping, areas of potentially suitable habitat, although not prevalent, may occur within portions of the corridors (PEF 2008a). Six scrub jays were observed in Marion County during reconnaissance surveys conducted along the 500-kV LNP-Central Florida South transmission-line corridor (PEF 2008a). In addition, populations are known to occur in the Halpata Tastanaki Preserve in Marion County, the southern perimeter of which is crossed by this corridor. FNAI records for the scrub jay are also known to occur for the associated corridors in Citrus County (PEF 2008a). Because wildlife reconnaissance surveys have been limited within the corridors and potentially suitable habitat is present in some places, it is possible that other scrub jay populations could occur on or near the associated offsite corridors.

Activities on the associated corridors therefore have the potential to affect the Florida scrub jay and its habitat. Because final rights-of-way would be narrow (100 to 220 ft wide) and mostly collocated with existing corridors, the actual extent of clearing would be greatly limited, thereby reducing the potential for scrub jay impacts. A condition of certification by FDEP would require protocol surveys for Florida scrub jays prior to "clearing and construction" within finalized rights-of-way (FDEP 2010a). If scrub jays are detected and impacts could not be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

Piping Plover – Threatened

LNP Site

The piping plover (*Charadrius melodus*) is a very rare to uncommon winter resident found on open, sandy beaches and tidal mudflats and sandflats along both coasts of Florida. It is not identified as potentially occurring in Levy County (FWS 2009a; FNAI 2009), and its favored sandy beach and tidal mudflat habitats do not occur on the LNP site. No piping plovers were observed on the LNP site during pedestrian surveys conducted over a 2-year period (PEF 2009a). The closest potential habitat (tidal mudflats) is more than 5 mi west of the site. It is therefore unlikely that piping plover would be affected by activities on the LNP site.

Associated Offsite Facilities

The piping plover is identified as potentially occurring in Pasco and Hillsborough counties through which the corridors pass (FWS 2009a; FNAI 2009). No piping plovers were observed during limited reconnaissance surveys conducted within the corridors. However, saltwater marsh is present within a small portion of the 230-kV CREC-to-Brookridge transmission-line corridor (PEF 2008a). Consequently, it is possible that tidal mudflats used by piping plover may occur on portions of this corridor. Nevertheless, impacts on this species are expected to be limited to a minor disturbance of loafing and foraging birds. Therefore, it is unlikely that piping plovers would be affected by the activities involving associated offsite facilities.

Florida Salt Marsh Vole – Endangered

LNP Site

The Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*) is a very rare small mammal known only from salt marsh habitat near Cedar Key and the Lower Suwannee National Wildlife Refuge in Levy County (FWS 2010b; FNAI 2009). No salt marsh habitat that could support this species is found on the LNP site. The closest salt marsh habitat is more than 5 mi west of the site, and the closest known location for the species is more than 30 mi to the west-northwest. It is therefore unlikely that Florida salt marsh vole would be affected by activities on the LNP site.

Associated Offsite Facilities

The Florida salt marsh vole is not identified as potentially occurring in the other counties through which the corridors pass (FWS 2009a; FNAI 2009). However, salt marsh habitat preferred by this species is present within a portion of the blowdown pipeline corridor between the LNP site and the CREC. Considering the proximity to known locations for this species, it is possible (though unlikely considering the rarity of this species) that salt marsh habitat along the blowdown pipeline corridor route could support the salt marsh vole. If this species is present, development activities along this corridor could disturb the Florida salt marsh vole and its habitat. A Condition of Certification by FDEP would require protocol surveys for Florida salt marsh vole prior to “clearing and construction” within suitable habitats in the finalized rights-of-way (FDEP 2010a). If salt marsh voles are detected and impacts cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation.

The review team is aware that PEF has proposed to the FDEP an alternate route to minimize impacts to important wetland habitats (including salt marsh) along the blowdown pipeline corridor route (PEF 2010b, c). FDEP has not made a decision on the proposal. Should the blowdown pipeline corridor be rerouted to avoid salt marsh habitat, no impact to Florida salt marsh vole would be expected.

Florida Panther – Endangered

<u>LNP Site</u>

The Florida panther (*Puma concolor coryi*) is a top of the food chain carnivore that historically ranged throughout Florida and much of the southeastern United States (FNAI 2009). This very rare subspecies is currently restricted to a small population of less than 100 animals in southwest Florida, where it occupies large expanses of upland and wetland forest habitat (Land et al. 2008). Young transient males are occasionally documented outside of the known breeding range. Considering the distance from the LNP site to the current breeding range of this species (more than 175 mi), it is unlikely that Florida panthers would be affected by activities on the LNP site.

<u>Associated Offsite Facilities</u>

The 230-kV Polk-Hillsborough-Pinellas transmission-line corridor would pass through the eastern perimeter of Polk County, which is identified as potentially supporting the Florida panther (FWS 2009a; FNAI 2009). Although outside of the known breeding range for the Florida panther, it is possible that young transient males could occasionally occur in Polk County. Therefore, project activities along the transmission-line corridor have the potential to affect the Florida panther. These impacts would likely be limited to temporary disturbance and displacement of individual animals that may at times travel north of the known breeding range. Because the final right-of-way for the Polk-Hillsborough-Pinellas transmission line would be narrow (about 100 ft wide) and mostly collocated with existing corridors, little clearing of habitat would occur. Consequently, the potential for fragmentation of suitable forest habitat that could support Florida panther would be limited.

Plants

<u>LNP Site</u>

No Federally listed plant species are known to occur in Levy or Citrus County (FWS 2009a; FNAI 2009). Consequently, it is unlikely that such plants would be affected by development activities on the LNP site.

<u>Associated Offsite Facilities</u>

Thirteen Federally listed plant species are identified as potentially occurring in the corridors (Table 2-8). None was observed during the limited reconnaissance surveys conducted within the corridors (PEF 2009a; Golder Associates 2008). However, one documented occurrence is known for the longspurred mint (*Dicerandra cornutissima*) from the PEF (2008a) and FFWCC (2009) databases. Potentially suitable habitat for many of these species may be present within portions of the corridors. Eleven of these plant species are usually associated with well-drained, sandy, xeric upland habitats, such as sandhill and scrub, and several may also occur on scrubby flatwoods, which are found on moderately well-drained sandy flatland. These include the Florida bonamia (*Bonamia grandiflora*), pygmy fringe tree (*Chionanthus pygmaeus*), Florida goldenaster (*Chrysopsis floridana*), longspurred mint, scrub wild buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*), Britton's beargrass (*Nolina brittoniana*), Lewton's polygala (*Polygala lewtonii*), Small's jointweed (*Polygonella myriophylla*), scrub plum (*Prunus geniculata*), wide-leaf warea (*Warea amplexifolia*), and Carter's mustard (*Warea carteri*). Although not prevalent, sandhill and scrub habitats are present along corridors supporting the associated offsite facilities, and clearing, grading, and other development activities have the potential to affect these species and their habitat. Two Federally listed plants associated with wetlands may also occur on the associated facilities corridors: Brooksville bellflower *(Campanula robinsiae*), which is found on wet grassy slopes and drying pond edges in Hernando County, and Cooley's water-willow *(Justicia cooleyi*), which occurs in mesic hardwood hammocks of central Florida. These two plants and their habitats may also be affected by development activities. Because final rights-of-way for the transmission lines would be narrow (100 to 220 ft wide) and collocated with existing corridors over most of their range, the actual extent of clearing required to build associated facilities is limited. This would reduce the area over which Federally listed plant species could be affected.

Federal Threatened and Endangered Species Summary

Based on wildlife reconnaissance surveys, life-history information, known threatened and endangered species locations, and information provided by PEF in its ER and responses to RAIs, little use of the LNP site is expected by Federally listed threatened and endangered terrestrial species. Only limited site reconnaissance work has been completed for threatened and endangered species along the associated offsite facilities (Golder Associates 2008). A condition of certification by the FDEP would require protocol surveys for State-listed species (excluding plants) that may occur on the LNP site and corridors prior to land "clearing and construction" (FDEP 2010a). All federally listed species potentially affected by the LNP project are also listed by the state of Florida, and are therefore subject to FDEP protocol survey requirements. If threatened or endangered species are identified and impacts cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation. Potential impacts to Federally listed threatened or endangered terrestrial species are also addressed in the biological assessment the review team prepared under Section 7 of the ESA. The biological assessment, which will be submitted to the FWS, is provided in Appendix F.

Restoration and enhancement of several hundred acres of low-ecological value pine plantations is proposed under the wetland mitigation plan for the LNP project (see Section 4.3.1.7). Commercial forest management would cease over portions of the site, and many pine plantations and other disturbed habitats would be restored to plant communities functionally similar to native upland and wetland habitats present prior to logging. Mitigation activities would entail land preservation, thinning of pines to more natural densities, targeted plantings of native species to improve species diversity, hydrologic restoration (e.g., culvert removal, ditch plugging, and planting bed removal), control of invasive species, and establishment of a prescribed fire regime (Entrix 2010). These actions are expected to be beneficial to most listed wildlife affected by the proposed LNP and could provide compensation for many potential impacts realized from development of the LNP and associated offsite facilities.

State-Listed Terrestrial Species

Florida-listed terrestrial species that may occur on or in the vicinity of the LNP site and associated offsite facilities are listed in Table 2-8. The State list includes species classified as endangered, threatened, or species of special concern. The potential impacts of development activities on these State-listed species are described below.

<u>LNP Site</u>

As many as 16 State-listed animals could, at times, use the LNP site (Table 2-8). Of these, the Florida scrub jay, wood stork, American alligator, and eastern indigo snake, which are also regulated under the ESA, are discussed under Federally listed species and not repeated here.

Targeted surveys for gopher tortoises conducted by PEF (2009a) detected the presence of this species in the southeastern portion of the LNP site. Most burrows were located along existing roads, edges of wetlands, and in spoil areas. Well-drained, sandy habitats preferred by the gopher tortoise are not prevalent on the LNP site. The shallow groundwater depth across much of the site acts to limit the distribution and density of gopher tortoise burrows, and the extensive alteration of upland habitats from decades of forest management has further degraded habitat suitability for this species. Nevertheless, clearing and grading activities pose a hazard to gopher tortoises, as well as to other State-listed species that occupy similar sandy uplands, such as the Florida pine snake (*Pituophis melanoleucus mugitus*), gopher frog (*Rana capito*), and Florida mouse (*Podomys floridanus*) – commensal species that use gopher tortoise burrow systems as a refuge – and the short-tailed snake (*Stilosoma extenuatum*). Gopher tortoises are also susceptible to traffic-related mortality, and construction traffic on the LNP site could contribute to additional losses for this species.

American kestrels (*Falco sparvenius*) have been observed on the LNP site (PEF 2009a, e), and it is possible that the listed resident subspecies, Southeastern American kestrel (*Falco sparverius paulus*), could occasionally visit open habitats on the site. A loss of potentially suitable habitat would occur with site clearing, and, if the listed subspecies is present, noise and human activity could disturb or displace individuals. Because kestrels are highly mobile and suitable habitats are widely dispersed in the project's vicinity, the impact on southeastern American kestrel from site-development activities is expected to be minor.

A variety of State-listed wading birds (e.g., little blue heron [*Egretta caerulea*], white ibis [*Eudocimus albus*], snowy egret [*Egretta thula*], tricolored heron [*Egretta tricolor*], and limpkin [*Aramus guarauna*]) may occasionally forage on the LNP site, but no wading bird rookeries are documented (PEF 2009a). Wading birds throughout central Florida forage in a variety of permanently and seasonally flooded wetlands, creeks, ditches, ponds, and lakes. Activities on the LNP site would remove over 300 ac of wetlands that could provide potential foraging habitat for wading birds, and birds foraging onsite could be disturbed or displaced by development activities. Because wading birds are highly mobile and similar wetland habitats are abundant in the project's vicinity, the impact on them from development activities on the LNP site is expected to be minor.

Although no Florida black bears were identified during field surveys of the LNP site, black bears may occasionally visit or move through the site (PEF 2009a). Habitat on the site has been degraded by decades of forest management, but the remaining forested wetlands could provide diurnal cover and foraging opportunities for black bears. Given their nature, Florida black bears would likely avoid the LNP site while development is ongoing. Nonetheless, loss and fragmentation of lower-quality black bear habitat could occur with site development.

The distribution of the Homosassa shrew includes a wide variety of upland and wetlands habitats throughout the northern two-thirds of peninsular Florida (Jones et al. 1991). Given the presence of suitable habitat on the LNP site, if this small secretive species is present, clearing and grading activities could pose a mortality hazard.

Forty-eight State listed plant species are identified as potentially occurring on the LNP site (Table 2-8), based upon distribution records and habitat preferences. No targeted surveys for individual State-listed plants have been conducted on the site. However, plant species were recorded by PEF contractors during extensive pedestrian surveys conducted between September 2006 and November 2008, in conjunction with habitat mapping and wetland delineation efforts (PEF 2009e). No State-listed plants were identified during these surveys (PEF 2009a). PEF (2008a) records identify five State-listed species from the LNP site vicinity – Godfrey's swampprivet (*Forestiera godfreyi*), pinewood dainties (*Phyllanthus leibmannianus*), corkwood (*Leitneria floridana*), spoonleaf sundew (*Drosera intermedia*), and coastal mock vervain (G*landularia maritima*). The past conversion of much of the LNP site to managed pine plantation reduces the likelihood that many of these rare plants are present. Nevertheless, clearing and grading activities could remove State-listed plants, particularly when native habitats are disturbed (e.g., mixed wetland hardwoods – FLUCFCS 617; cypress swamp – FLUFCS 621; wetland forested mixed – FLUCFCS 630; and freshwater marsh – FLUCFCS 641).

A condition of certification by the FDEP would require protocol surveys for State-listed species (excluding plants) prior to "clearing and construction" on the LNP site (FDEP 2010a). If State-listed species are detected and impacts cannot be avoided, appropriate mitigation could be required on a case-by-case basis. For example, the capture and relocation of any gopher tortoises that occupy habitat to be affected by project activities would be required pursuant to permitting authorized by the FFWCC. Under wetland mitigation planning for the LNP project, commercial forest management would cease on portions of the remaining undisturbed lands on the LNP site, and many pine plantations and other disturbed habitats would be rehabilitated and restored to native upland and wetland plant communities (see Section 4.3.1.7). The higher-quality habitat provided by these restored communities would likely be beneficial to many State-listed species.

<u>Associated Offsite Facilities</u>

As many as 32 State-listed animals and 76 State-listed plants could occur along the corridors (Table 2-8). Many of these plant and animal species are usually associated with well-drained, sandy, xeric upland habitats, such as sandhill and scrub. Although not prevalent, sandhill and scrub habitats are present along corridors supporting the associated offsite facilities. Limited reconnaissance surveys (PEF 2009a, e; Golder Associates 2008) and PEF (2008a) and FFWCC (2009) database searches of the corridors have verified the presence of species, such as Sherman's fox squirrels (*Sciurus niger shermani*), Florida scrub jays, gopher tortoises, longspurred mint, and giant orchid (*Pteroglossaspis ecristata*); and potentially suitable habitat was identified for many other State-listed species (see Table 2-8). Targeted surveys for gopher tortoise in portions of the corridor segment between the LNP site and the CFBC detected numerous burrows for this species. Considering the linear extent of the associated facilities corridors and the variety of habitats through which they pass, it is possible that other State-listed plants and animals may be present.

Vegetation clearing, grading, and other development activities necessary to site the associated offsite facilities have the potential to affect many of these State-listed species and their habitats. Many State-listed mammals and most State-listed birds are highly mobile and should be able to avoid mortality during clearing and grading. However, more sedentary animals, such as reptiles and amphibians, are susceptible to injury or mortality during clearing and grading. Forest-dependent species may suffer local population declines as suitable forest habitat is permanently cleared for the final rights-of-way. However, if corridor management does not reduce suitability, species known to exploit disturbed corridors, such as the gopher tortoise, fox squirrel, and burrowing owl (*Athene cunicularia floridana*), may benefit after vegetation reestablishes. The impacts on State-listed animals associated with coastal tidelands and waters are expected to be limited to temporary noise disturbance or displacement. If State-listed plants are physically disturbed during clearing and grading or become stressed by microhabitat changes, these populations could decline in vigor, be reduced, or be eliminated. However, the conditions created and to be maintained along some corridors (e.g., low-growing non-woody habitats) could favor establishment of other listed plant species.

The final rights-of-way for the transmission lines and their substations would be determined as a post-certification effort under the PPSA. Because the final rights-of-way would be narrow (100 to 220 ft wide) and collocated with existing corridors over most of their range, the actual extent of clearing required to site associated facilities is greatly limited. As a condition of certification by the FDEP (2010a), PEF is obliged to conduct protocol surveys for State-listed species (excluding plants) prior to "clearing and construction." If State-listed species are detected and impacts cannot be avoided, appropriate mitigation could be required on a case-by-case basis. For example, the capture and relocation of any gopher tortoises that occupy habitat to be affected by site development would be required pursuant to permitting authorized by the FFWCC. Under wetland mitigation planning for the LNP project, commercial forest management would cease on approximately 1549 ac of undisturbed lands on the LNP site and property owned by PEF directly to the south, and pine plantations and other disturbed habitats would be rehabilitated and restored to native upland and wetland plant communities (see Section 4.3.1.7). The higher-quality habitat provided by these restored communities would likely be beneficial to many State-listed species.

Other Important Terrestrial Species and Habitats

<u>LNP Site</u>

Other than wetlands, no unique or rare habitats, or habitats with priority for protection are identified on the LNP site as being potentially affected by development activities (PEF 2009a). Plant communities on the LNP site have been extensively altered by decades of intensive forest management. The Goethe State Forest is located along the northeast border of the LNP site, but the closest LNP development activities (other than conservation-related mitigation activities) would be more than 1 mi from the Goethe State Forest boundary. Perimeter fencing would not be erected around the LNP property line in a way that could disrupt movement and dispersal of wildlife between the Goethe State Forest and the northern portion of the LNP site, which would remain undeveloped. Fencing would be limited to areas close to plant facilities to provide for security or industrial safety (PEF 2009g). Daytime noise could present a minor disturbance impact on wildlife in the Goethe State Forest during very limited periods of intense activity (e.g., pile driving). No other development-related impacts on terrestrial resources found within preserves or conservation areas are expected.

Some recreationally valuable game species that occupy the LNP site (e.g., white-tailed deer, bobwhite quail, wild turkey [*Meleagris gallopavo*]) would be affected by development activities. These highly mobile species should be able to avoid mortality during site clearing, but local population declines may occur due to habitat loss and fragmentation, and from competition for resources on lands to which they are displaced. These impacts on game species are considered minor because they and their preferred habitats are locally abundant.

Federally protected under the Bald and Golden Eagle Protection Act of 1940, bald eagles (*Haliaeetus leucocephalus*) also are expected to incur minor impacts. The LNP site does not provide quality aquatic foraging habitat for the bald eagle, and nesting is not documented there. However, several bald eagle nests are known to exist between 1 and 2 mi from the LNP site. If these nests are active during the bald eagle nesting season (October 1–May 25), daytime noise could represent a minor disturbance impact during very limited periods of intense development activity (e.g., pile driving) near active nests.

Little impact on whooping cranes is expected from actions on the LNP site. No whooping cranes were identified during field surveys of the LNP site (PEF 2009a, e). Whooping cranes could pass near the LNP site during their seasonal migrations, and birds from the nonmigratory population could stray into this area. Although recently cutover forestland and emergent wetlands could provide some low quality foraging habitat, use of the LNP site by whooping cranes is highly unlikely and any use would likely be incidental.

<u>Associated Offsite Facilities</u>

A number of wetlands (see Section 4.3.1.2) wildlife sanctuaries, refuges, and preserves (see Section 2.4.1.4) lie near or are crossed by the corridors. Clearing for the final rights-of-way traversing or adjoining these conservation areas could alter native habitats that are presently preserved. However, development impacts are expected to be minor because the final rights-of-way would be narrow (100 to 220 ft wide) and collocated with existing PEF corridors through or along most of these areas. This would minimize the actual extent of clearing required within conservation areas and limit further fragmentation to terrestrial resources. Any forested wetlands that lie within cleared zones would be converted to an herbaceous or scrub-shrub condition, retaining partial wetland functions. Lands bordering streams classified as Outstanding Florida Waters would be spanned by the transmission lines (i.e., Withlacoochee River, Blackwater Creek, Hillsborough River, Trout Creek, Cypress Creek), thereby avoiding impact on these resources.

A variety of recreationally valuable game species is expected to occur along the associated offsite facilities wherever suitable habitat is present. Most of these species are highly mobile and should be able to avoid mortality during site clearing. Forest-dependent game species, such as gray squirrels, may suffer local population declines as suitable forest habitat is permanently cleared for the final rights-of-way. However, many of the other game species are multicover users (e.g., white-tailed deer and mourning dove [*Zenaida macroura*]), inhabit early successional upland (e.g., northern bobwhite and eastern cottontail rabbit), or wetland (e.g., common snipe [*Gallinago gallinago*]) communities. Unless landowner management reduces habitat suitability, these species likely would benefit following the reestablishment of herbaceous and shrub vegetation within cleared rights-of-way. Because these game species and their habitats are abundant throughout central Florida, impacts on them are considered to be minor for corridors both up to and beyond the first substations.

Bald eagles are widely distributed throughout central Florida wherever suitable aquatic foraging habitat is present. A number of bald eagle nests (both active and inactive) exist within or near the corridors for the associated offsite facilities, including corridors both up to and beyond the first substations. Activities within the associated corridors have the potential to affect nesting bald eagles. A condition of certification by the FDEP would require protocol surveys for bald eagles prior to "clearing and construction" for the associated offsite facilities (FDEP 2010a). If impacts on bald eagle nests cannot be avoided following FWS (2007) and the FFWCC (2008) guidelines for bald eagles, PEF would need to obtain a FFWCC Eagle Permit as conditioned by the FDEP (2010a) and FWS authorization under the Bald and Golden Eagle Protection Act.

Whooping cranes, although rare, may occasionally occur within areas through which the offsite corridors would pass. Substantial portions of the transmission-line corridors lie within the primary range of the nonmigratory Kissimmee Prairie population, and the CREC-to-Brookridge corridor would pass within 2 mi of the wintering site for the migratory whooping crane population. Although no records or observations of whooping crane are known from the offsite corridors, emergent wetlands, or maintained grasslands, and other suitable foraging habitats do lie within these corridors. Development activities along the corridors could result in minor disturbances to loafing or foraging birds. Newly cleared rights-of-way could provide additional foraging habitat (for example, forested wetlands converted to emergent wetlands).

4.3.1.4 Floodplains and Historic Basin Storage

Floodplains are normally dry or semi-dry lands that provide temporary natural storage areas for floodwater. Although development within floodplains is not prohibited under Florida statutes, compensating storage is required for encroachment into the 100-year floodplain that would adversely affect conveyance, storage, water quality, or adjacent lands (SWFWMD 2009). To allow storage during lesser flood events, any required compensating storage must be provided between the seasonal high-water level and the 100-year flood level. Historic basin storage is the retention storage provided by topographic depressions present on a site (in floodplains or elsewhere) prior to development. Stormwater captured by historic basin storage remains onsite, unable to run off, and loss occurs by evaporation or percolation into the soil. Florida statutes require replacement or mitigation for the loss of historic basin storage from a project site (SWFWMD 2009).

The distinction between floodplain storage and historic basin storage is landscape dependent. In general, floodplain storage is the detention volume above the landscape elevation where stormwater runoff occurs by sheet flow from natural low areas. Historic basin storage is the detention and/or retention volume below this discharge elevation. Floodplain and historic basin storage areas act to minimize flood damage to adjacent areas, recharge groundwater aquifers, improve water quality by capturing sediments and other contaminants, and provide specialized natural habitats for many plant and animal species.

Development of the LNP project would require placing permanent fill into the 100 year floodplain as mapped by FEMA and into historic basin storage areas. For the purposes of this Draft EIS, PEF prepared a preliminary floodplain analysis to estimate the maximum amount of floodplain and historic basin storage encroachment that could occur, and to demonstrate that adequate floodplain compensation is feasible (CH2M HILL 2009a). Encroachment by fill into the 100-year floodplain (estimated volume of 252.4 ac-ft) and into historic basin storage (estimated volumes of 73.9 ac-ft for connected floodplains and 13.9 ac-ft for isolated floodplains) was calculated using a “volume for volume” analysis for the LNP site and for the associated offsite facilities lying between the LNP site and the CFBC. Refer to Section 4.2.1 for a detailed accounting of the preliminary floodplain analysis. PEF intends to prepare a revised floodplain analysis utilizing a dynamic modeling approach to estimate floodplain and historic basin storage encroachment and compensation requirement to satisfy formal floodplain permitting under the ERP. PEF identified 5 potential floodplain compensation areas on lands it owns immediately south of the LNP site that encompass about approximately 322 ac, where excavation could yield up to 320.9 ac-ft of floodplain compensating storage (CH2M HILL 2009a). These 5 areas presently support upland vegetation that has mostly been degraded by prior forest-management activities such as coniferous plantations (FLUCFCS 441) and other open lands (rural) (FLUCFCS 260). No wetlands are identified in these areas (Table 4-8). Compensation for fill within historic basin storage would not require the disturbance of additional land area. Compensation for loss of historic basin storage in connected floodplains could be provided by excavating depressions below the seasonal high groundwater level within the five potential floodplain compensation areas to trap and retain floodwater. According to SWFWMD policy, permanent pool volume within the proposed wet detention ponds, which total 105 ac in area, can serve as compensation storage for the loss of historic basin storage from isolated (i.e., not connected) floodplains. For a detailed account of the potential availability of compensating storage, refer to Section 4.2, Water-Related Impacts. Based upon the preliminary floodplain analysis, there appears to be adequate upland area available on lands south of the LNP site to compensate for floodplain and historic basin storage losses.

As noted, additional upland impacts of roughly 250 ac could be required to compensate for LNP project floodplain losses, depending upon the results of the dynamic modeling approach for floodplain assessment. Floodplain compensation areas would be cleared of existing vegetation, excavated to achieve available storage volume, and restored to native plant communities typical of natural floodplains in the region. Wildlife occupying these areas would be subjected to many of the same types of development impacts as described for the LNP site. Some wildlife would perish or be displaced during clearing and excavation. Less mobile animals, such as reptiles, amphibians, and small mammals, would incur greater mortality than more mobile animals, such

Table 4-8. Cover Types Present Within Potential Floodplain Compensation Areas

Compensation Site	Area (ac)	FLUCFCS Code[(a)]	FLUCFCS Description	Area (ac) by FLUCFCS Type	Percent of Compensation Site
C-74	20.1	441	Coniferous Plantations[(b)]	20.1	100
C-76A	84.9	260	Other Open Lands <Rural>	14.4	17.0
		410	Upland Coniferous Forest	3.5	4.1
		441	Coniferous Plantations[(b)]	67.0	78.9
C-76B	78.5	260	Other Open Lands <Rural>	50.8	64.7
		434	Hardwood Conifer Mixed	3.8	4.8
		441	Coniferous Plantations[(b)]	23.8	30.3
C-76C	102.9	260	Other Open Lands <Rural>	20.4	19.8
		441	Coniferous Plantations[(b)]	82.5	80.2
C-96A	9.3	260	Other Open Lands <Rural>	1.9	20.4
		441	Coniferous Plantations[(b)]	7.4	79.6
C-100	10.7	441	Coniferous Plantations[(b)]	10.7	100
C-101	15.6	441	Coniferous Plantations[(b)]	15.6	100
Total Area	322.0			322.0	

Sources: CH2M HILL 2009a, FDOT 1999.
(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System.
(b) All tree plantations were assumed to be planted in pine and classified as coniferous plantations (FLUCFCS 441).

as birds, which would be displaced to adjacent communities. Land clearing conducted during the spring and/or early summer nesting periods would be detrimental to avian reproductive success. Wildlife would also be subjected to minor, short-term impacts from noise and traffic. Adjacent habitats could support some displaced wildlife, but increased competition for available space and resources likely would depress population levels. As restored habitats become available for use by wildlife, the higher-quality habitat provided by the restored communities would allow for an increase in wildlife diversity and species population levels.

Although degraded from past forest-management activities, it is possible that floodplain compensation areas could support listed species, particularly the State-listed gopher tortoise and those species commensal with the tortoise. A condition of certification by the FDEP would require protocol surveys for all State-listed species (excluding plants) prior to land "clearing and construction" for the LNP project (FDEP 2010a). If listed species are identified on floodplain compensation areas, PEF intends to avoid these areas (CH2M HILL 2009a). If listed species are identified on floodplain compensation areas, PEF would attempt to avoid these areas (CH2M HILL 2009a). If these areas cannot be avoided, PEF would be required to coordinate with the FFWCC to determine the need for appropriate mitigation. Potential impacts to Federally listed threatened or endangered terrestrial species are addressed in the biological assessment the review team prepared under Section 7 of the ESA. The biological assessment is provided in Appendix F.

Additional floodplain and historic basin storage encroachment (not yet determined) would be incurred to develop the offsite facilities, primarily the transmission lines. Because new transmission lines would be collocated with existing PEF transmission lines over about 90 percent of their distance, opportunities should be available to situate most access roads and tower pad sites outside of floodplains and depressions that provide historic basin storage. Most pipeline length would be installed in trenches and backfilled to restore existing grade, and hence existing surface water runoff patterns. Compensation storage for floodplain and historic basin storage encroachment that cannot be avoided typically would be provided immediately adjacent to the resource area within the approved right-of-way and addressed through the Florida ERP process (CH2M HILL 2009a).

4.3.1.5 Impacts from Fill Acquisition

Another potential source of terrestrial resource impacts is mining of fill material used during building activities at the LNP site. PEF has not yet determined where it would obtain its needed fill material. However, to provide the reader with additional context of the potential impacts of fill mining, the review team has assessed impacts assuming that PEF would obtain its entire fill from the proposed Tarmac King Road Limestone Mine. Due to the proximity of the Tarmac mine to the LNP site, use of the Tarmac mine would cumulatively affect many of the same terrestrial habitats as those affected by the LNP project. Considering the proximity of the two sites and the presence of wetlands and other sensitive coastal habitats on both sites, use of the Tarmac mine would constitute a worst-case bounding assumption for assessing potential impacts from fill acquisition attributable to the Levy project. The proposed Tarmac mine would be located 1 mi west of the intersection of US-19 and King Road in Levy County, about 2 mi west of the LNP site. Additional information regarding the Tarmac mine is provided in Chapter 7.

Tarmac has applied for permits to begin site development in 2011, with operations beginning in 2013. Development of the Tarmac mine would result in the phased disturbance of up to 4000 ac of terrestrial habitats and resources over a 100-year period, including approximately 1140 ac of wetlands (BRA 2010). Terrestrial resources on the mine site are generally similar to those found on the LNP site and vicinity. Impacts on terrestrial resources would include upland and wetland habitat loss and fragmentation, hydrological alterations to adjoining wetlands, sedimentation and erosion, noise from blasting and operations, impacts from fugitive dust, and traffic-related wildlife mortalities. These impacts, while substantial, would be localized. Tarmac plans to mitigate for wetland impacts by conducting a variety of conservation measures on a 4500-ac site adjacent to the proposed mine site that would be protected by a conservation easement. The Tarmac Mine would not be developed solely for providing fill material to the LNP site. The same would be true for other commercial mines used by PEF as sources of fill. Therefore only a portion of the impacts from any mine would be considered directly attributable to the LNP project.

4.3.1.6 Terrestrial Monitoring

PEF plans to perform monitoring for species and habitats as required by Federal and State regulatory agencies during site preparation and development at the LNP site and associated offsite facilities (PEF 2009a). To meet responsibilities under Section 7 of the ESA, the review team has prepared a biological assessment that documents potential LNP project effects on Federally listed threatened or endangered terrestrial species (see Appendix F). If adverse effects on Federally listed species are predicted, PEF would be required to comply with any monitoring specified in the Biological Opinion issued by the FWS. Monitoring of certain State listed species may be required by the FDEP (2010a). Bald eagle nests are documented near the LNP site and associated facilities. Monitoring could be required if development activities are anticipated to occur within 660 ft of active nests (FWS 2007; FFWCC 2008). No monitoring of recreationally important species is anticipated because these species and their habitat are locally abundant.

Monitoring of wetlands during site preparation and development could be required under the CWA Section 404 permit issued by the USACE and the ERP issued by the State of Florida. PEF has prepared a wetland mitigation plan (Entrix 2010) to compensate for the loss or impairment of wetland functions during project development (see Section 4.3.1.7). It is expected that implementation of the wetland mitigation plan would begin during the 8-year project-development period.

Monitoring of wetland and upland communities enhanced under the plan is an important component of this adaptive management plan. Monitoring would be conducted annually using permanent transects and sample plots located in habitats representing all vegetative communities present in mitigation areas (PEF 2009l). Data to be collected includes vegetative species composition and cover by stratum (e.g., ground, shrub understory, and tree canopy), hydrologic indicators (e.g., percent cover of water and water depth), invasive species presence, and documentation of wildlife observations. Transects and location data would be mapped using a global positioning system and selected sampling points would be photo documented. Monitoring results would be reported annually to appropriate regulatory agencies.

PEF also plans to perform hydrological monitoring during temporary groundwater dewatering associated with excavation for the powerblocks. If any detrimental impact on water levels supporting adjacent wetlands were to be detected during monitoring, mitigative measures, such as additional drilling and grouting, sheeting, or re-design of the recharge basins, would be implemented (PEF 2009c). This monitoring is discussed further in Section 4.2.4.

4.3.1.7 Potential Mitigation Measures for Terrestrial Impacts

PEF has proposed mitigation measures intended to reduce and compensate for impacts on terrestrial resources expected during site preparation and development for the LNP project. A brief summary of these mitigation measures follows.

Wetland Mitigation Plan

PEF submitted a wetland mitigation plan to the FDEP on April 30, 2010 (Entrix 2010), fulfilling a State condition of certification imposed by the FDEP (2010a) under the Florida PPSA. The plan outlines compensation for the loss or impairment of functions in wetlands affected by both activities on the LNP site and on the associated offsite corridors, including transmission line corridors. Both the FDEP and the USACE will review the wetland mitigation plan for compliance with Federal Clean Water Act Section 404 and Florida ERP permitting processes. PEF is required under these Federal and State permitting processes to avoid or minimize wetland impacts to the extent practicable, and to mitigate for unavoidable impacts by fully offsetting the functional wetland losses predicted to occur from the LNP project. The wetland mitigation plan is based upon conservative wetland impact assumptions to ensure that adequate compensation is achieved. Impacts on both jurisdictional and non-jurisdictional wetlands are pooled for the impacts analysis, and both temporary and partial wetland impacts are treated as permanent. The extent of wetland impacts from building the transmission lines is a rough estimate because final rights-of-way have not been selected. Under the PPSA, final impacts would be determined through a post-certification process. Using conservative assumptions regarding the likely rights-of-way ultimately selected for the transmission lines within the identified corridors, PEF estimated potential wetland impacts and calculated UMAM functional losses. To comply with USACE and FDEP regulatory requirements, PEF is obliged to minimize impacts on wetlands while routing final transmission-line corridors and during installation of the lines. Consequently, actual impacts likely would be less than those predicted due to the expected ability to identify practicable avoidance and minimization opportunities during upcoming detailed planning and development phases for each transmission-line segment.

The wetland mitigation plan provides a landscape-level ecosystem benefit by enhancing and restoring ecological functions to several hundred acres of wetland habitat and supporting uplands in each watershed affected by wetland impacts (Entrix 2010). It identifies several geographically distinct mitigation parcels in each affected watershed that could be combined to achieve needed mitigation credits. The purchase of mitigation credits from established wetland mitigation banks was also considered; however, regional banks are unlikely to have enough available credits to fully meet PEF's mitigation requirements. About half of the proposed wetland impacts (by acreage and relative functional loss of impact) would occur on or near the LNP site in the Waccasassa and Withlacoochee river watersheds. However, wetland impacts associated with the transmission-line corridors would span several other watersheds as small, disconnected, linearly distributed footprints of impacts.

Most of the mitigation areas identified in the plan are former Florida flatwoods and wetlands that have been subjected to intense forest management. Most have been converted to pine plantations managed on a short harvest rotation of less than 30 years. Activities such as bedding, planting of slash pine, repeated harvesting, fire suppression, ditching, and road building and maintenance have severely degraded wetland functions and value. The wetland mitigation plan primarily targets the restoration and rehabilitation of degraded wetlands and uplands. Intensive commercial forest management would cease in mitigation areas, and pine plantations and other disturbed habitats would be restored to plant communities functionally similar to native upland and wetland habitats present prior to initial logging. Other mitigation activities would entail selective thinning of planted pines to more natural densities, targeted plantings of native species to improve species diversity, hydrologic restoration of wetlands (e.g., culvert removal, ditch plugging, and bed removal), control of invasive species, and the establishment of a prescribed fire regime (Entrix 2010).

A UMAM assessment was completed to evaluate wetland functional losses from the LNP project and estimate wetland functional gains that could be realized with implementation of the wetland mitigation plan (Entrix 2010). Results are presented in Table 4-9. The preliminary assessment assumed the LNP project would result in a loss of approximately 289 UMAM functional units, spread over five watersheds. The plan could generate a functional lift (i.e., a gain in function) of approximately 490 UMAM units, substantially more than the minimum needed to achieve no net loss of wetland function. The net UMAM gain generated by implementation of the proposed mitigation would be approximately 201 lift units, or nearly a 70 percent gain in functional value expressed in terms used by the UMAM process. The lift would be spread over all five affected watersheds, although not in exact proportion to the impacts.

Table 4-9. Preliminary UMAM Assessment for the LNP Project

Impact Watershed	UMAM Impact Units (Losses)	Mitigation Component (Showing Watershed[s] Served)	Action	UMAM Lift Units (Gains)		
				Wetland	**Upland**	**Total**
Waccasassa	-182.4	Daniels Island Tract, GSF[(a)]	Re-establishment and rehabilitation of wetlands on land owned by the Division of Forestry	61.1	0	**61.1**
Withlacoochee	-50.1	LNP Site[(b)]	Rehabilitation (enhancement) and preservation of wetlands and adjoining uplands on land owned by the applicant	180.6	145.0	**325.6**
Hillsborough	-16.6	Boarshead Ranch	Re-establishment, rehabilitation, creation, and preservation of wetlands on privately owned dedicated for conservation	52.9	0	**52.9**
Upper Coastal	-33.6	Five Mile Creek	Re-establishment and creation of wetlands and rehabilitation of wetlands and adjoining uplands on land owned by Pasco County	4.7	0.6	**5.3**
		Homosassa Tract, WSF[(c)]	Re-establishment of wetlands and rehabilitation of wetlands and adjoining uplands on land owned by the Division of Forestry	34.3	1.8	**36.1**
Tampa Bay	-6.6	Brooker Creek	Re-establishment and rehabilitation of wetlands on land owned by Pinellas County	9.2	0	**9.2**
Total	**-289.3**			**342.8**	**147.4**	**490.2**

Source: Entrix 2010.
(a) GSF – Goethe State Forest.
(b) Includes property south of the LNP site owned by PEF.
(c) WSF – Withlacoochee State Forest.

The plan seeks to distribute lift to the benefit of all affected watersheds using a few strategically chosen locations that improve and expand existing conservation areas and meet regional watershed conservation goals.

Avian Protection Plan

In coordination with the FFWCC and FWS, PEF would be required to prepare an Avian Protection Plan as a condition of certification by the FDEP (2010a). The plan would seek to reduce the risk to birds posed by development and operation of the LNP transmission lines and other electric utility facilities with the goal of reducing avian mortality. The specific mitigation measures to be included in the plan would be developed concurrently with final design and routing of the transmission lines. Pursuant to PPSA, the determination of the final rights-of-way for the transmission lines would be determined through a post-certification process.

Temporary Restoration Plan

PEF would develop BMPs to restore temporarily disturbed areas on the LNP site and for the associated offsite facilities (PEF 2009e). Temporarily disturbed areas would be regraded to pre-existing contours after development activities have ceased (PEF 2009c). Sediment- and erosion-control measures, such as silt fencing and seed mixtures, would be used to limit erosion and minimize impacts on terrestrial and wetland resources. Uplands would be seeded in accordance with project-developed sedimentation- and erosion-control plans, while wetlands would be allowed to regenerate naturally from the existing wetland seed bank (PEF 2009e). All vegetation-management activities would be supervised by PEF or qualified contractors under PEF control. Invasive species monitoring and control would be conducted as needed to promote restoration to desired conditions.

4.3.1.8 Summary of Impacts on Terrestrial Resources

The review team evaluated the potential impacts to terrestrial ecological resources from building the proposed LNP Units 1 and 2 and the associated offsite facilities, including but not limited to water pipelines, a heavy haul road, and transmission lines and substations. Development of the LNP project would proceed according to Federal and State regulations, permit conditions, existing procedures, and established BMPs. Permanent cover type (habitat) losses would total about 627 ac on the LNP site and roughly 2008 ac for the associated offsite facilities (offsite impacts for the transmission lines are based on preliminary rights-of-way) (Tables 2-6 and 2-7). Additional temporary habitat losses are estimated at about 150 acres for the LNP site and 30 ac for the associated offsite facilities (note – temporary impacts associated with transmission line installation are treated as permanent for this analysis). Up to an additional 250 ac of habitats (primarily degraded uplands) may have to be excavated to lower elevations to create enough new floodplain storage capacity to compensate for LNP site encroachments into the 100-year floodplain; lands disturbed for floodplain expansion would, however, be restored to native vegetation.

Although wetlands would be avoided to the extent possible, the proposed LNP project is estimated to permanently affect approximately 683 ac of wetlands (319 ac on the LNP site and roughly 364 ac for the associated offsite facilities) and temporarily impact another 90 ac of wetlands (84 ac on the LNP site and 6 ac for the associated offsite facilities) (Tables 2-6 and 2-7). Because pre-project hydrology would be restored within no more than 4 years, additional temporary wetland impacts (not quantified) that may occur during dewatering are not considered significant. Many of the upland and wetland cover types that would be affected by the proposed development have been altered by prior land-use activities, particularly commercial forest management on the LNP site. Although the loss and alteration of wetlands are substantial, PEF has proposed a mitigation plan to compensate for the loss or impairment of functions in wetlands affected by development. Compensation for unavoidable wetland impacts is required under both the Clean Water Act Section 404 permit and the Florida ERP processes.

Site preparation and development for the proposed LNP project would affect wildlife and important species as defined by the NRC. The review team has determined that habitat loss, hazards posed by site preparation, noise, collisions with elevated structures, and increased traffic may adversely affect wildlife. However, the impacts on wildlife populations are expected to be localized in their effect, and mitigable through onsite habitat enhancement and conservation measures.

Federal and State-listed threatened and endangered species, at times, may occur on or in the vicinity the LNP site and the associated offsite facilities. As many as 32 listed wildlife species (9 Federally listed and 32 State-listed) and 76 listed plant species (13 Federally listed and 76 State-listed) could be affected (see Table 2-8). To comply with Section 7 of the ESA, the review team has prepared a biological assessment that documents potential LNP project effects on Federally listed threatened or endangered terrestrial species. The biological assessment is provided in Appendix F. A condition of certification by the FDEP (2010a) would require protocol surveys for all State-listed species (excluding plants) that may occur on the LNP site and associated offsite facilities prior to land "clearing and construction." If listed species are identified during predevelopment surveys or are encountered during development, this condition of State certification by FDEP also requires PEF to consult with the FFWCC to determine the need for appropriate mitigation (FDEP 2010a). Provided that adequate surveys are conducted prior to commencement of development, consultation with the FWS and FFWCC is initiated as needed, the wetland mitigation plan is initiated at the scope and scale proposed, and other identified mitigation is implemented, impacts on threatened and endangered species from the LNP project likely would be minimized. However, without proper surveys, consultation, and appropriate mitigation, the impact would be substantially greater.

Based on the review team's independent evaluation of the LNP project, including the ER, the SCA, PEF's responses to NRC's Requests for Additional Information, the identified mitigation measures and BMPs, and consultation with other federal and state regulatory agencies, the review team concludes that the impacts of construction and preconstruction activities to terrestrial ecological resources (including wetlands and threatened and endangered species) would be MODERATE. This moderate conclusion reflects the impacts on wetlands, wildlife, and Federally and State-listed species at the LNP site and the associated offsite facilities. Even with implementation of best management practices, the proposed wetland mitigation plan, and other mitigation outlined in the SCA application, the review team believes that the impacts to wetland and upland terrestrial habitats and their associated wildlife would still be noticeable in the surrounding landscape, especially in the short term. However, the review team also believes that the proposed mitigation measures, especially those in the wetland mitigation plan, would substantially offset the adverse losses to upland as well as wetland habitats in the long term. The review team therefore concludes that the terrestrial impacts resulting from the Levy project would not destabilize the continued existence of any wetland or upland habitats and associated wildlife in the surrounding landscape.

The LWA rule (72 FR 57416) specifically states that transmission lines, pipelines, heavy-haul roads and other offsite actions that support the proposed LNP project are not included in the definition of construction. NRC-authorized construction activities would be limited to activities necessary to develop safety-related structures on the LNP site, a subset of the total development activities on the site analyzed above for impacts on terrestrial resources. NRC-authorized construction activities with the potential to affect terrestrial species and habitats include the use of cranes and the erection of safety-related structures; movement of construction vehicles and heavy equipment around the site; the noise associated with construction, machinery, and testing of diesel and combustion turbine generators; and minor changes in surface-water drainage. These NRC-authorized construction activities are not expected to increase floral or faunal mortality rates enough to destabilize affected populations, and detectable changes in abundance would not be expected at a regional population level. In addition, impacts to wetlands and important terrestrial species during NRC-authorized construction activities are expected to be minor. Temporary water table fluctuations caused by dewatering the power block excavations during construction are not expected to affect wetland hydrology outside of the known range of natural periodic water table fluctuations. Based on these analyses, the NRC staff concludes that impacts to terrestrial ecological resources from NRC-authorized construction activities would be SMALL, and no mitigation beyond the actions stated would be warranted.

4.3.2 Aquatic Impacts

Impacts on the aquatic ecosystem from building proposed LNP Units 1 and 2 would mainly be associated with impacts on LNP site ponds, CFBC, Inglis Lock bypass channel, and the CREC

Crystal Bay discharge area. A few small ponds that exist on the LNP site would be filled to accommodate preparation of facilities. The CFBC would be affected by the installation of a water-intake system, placement of discharge piping, and connection of a barge-unloading facility to the CFBC. The Inglis Lock bypass channel may be affected by building activities associated with crossing intake and discharge pipelines. The CREC discharge canal would be affected by installation of a discharge outfall.

The Withlacoochee River, Hillsborough River, and other small lakes and streams are within existing transmission-line corridors and would be crossed by additional transmission lines. The new transmission lines are expected to span these waterbodies.

4.3.2.1 Aquatic Resources – Site and Vicinity

LNP Site

A few of the intermittent ponds described in Section 2.4.2 would be permanently filled for preparation of facilities, but other onsite ponds would be unaffected. Ponds on the LNP site were examined visually for aquatic species and were not observed to have active populations of fish or macroinvertebrates due to the shallow or seasonal nature of these habitats. Years of forest-plantation activities on the LNP site potentially contributed to lack of viable aquatic communities in these resources (PEF 2009a). Erosion and runoff mitigation practices would be used to prevent siltation of preserved ponds onsite (PEF 2009i). Stormwater-management basins and cessation of forest-plantation activities on the site would likely create improved freshwater aquatic habitat (PEF 2009a).

CFBC

The installation of the intake structure, connection of a barge slip to the CFBC, and placement of discharge piping would result in temporary disturbances to the aquatic habitat in portions of the CFBC. Until excavation is complete, preparation of the barge slip would occur on the northern shore of the CFBC in upland areas behind an earth bank that separates the barge slip excavation activities from the CFBC (see Figure 3-1). The intake structure would be installed 0.5 mi downstream of the Inglis Lock. Steel sheet piling would be installed at the barge slip and in a cofferdam for intake structure installation. Sheet piles would be driven from land using a pile hammer. Turbidity barriers and erosion-control measures would be installed in the canal during activities associated with sheet-pile installation to control impacts on water quality (Figure 3-5).

Building activities are expected to commence with installation of permanent piling over a 60-week time frame for the barge slip and over a 13-week period for temporary piling at the intake structure. Removal of temporary piling at the intake structure is expected to occur after 6 months of installation activities proposed for an October–March time frame. Turbidity barriers and erosion-control measures are expected to be installed commensurate with piling-installation activities and remain in place prior to operations (PEF 2008a). Use of BMPs and measures to control water quality should prevent adverse impacts to the few species that inhabit the portion of the CFBC near the proposed intake. Motile invertebrates, fish, sea turtles, or manatees may swim into this portion of the CFBC, but they would be able to swim away or likely would avoid the area due to vibratory noise. Mobile, benthic invertebrates in this area, primarily polychaetes, may be able to occupy adjacent habitat in the CFBC because installation activities would take place only along the northern shore. However, sessile invertebrates in this area, such as the false dark mussel (*Mytilopsis leucophaeata*) and barnacles (*Chthamalus fragilis*), would be affected by removal and modification of shoreline structures in the affected areas only. Section 4.3.2.3 of this chapter discusses additional concerns related to the impacts of building on important species.

Dredging would be necessary for preparation of a trench for two 54-in.-diameter discharge pipes across the 150-ft width of the CFBC. PEF has committed to testing any sediments to be removed by dredging prior to dredging using EPA Method 1311 for toxicity characteristics for determination of final disposition of dredged spoil materials. Nonhazardous sediments would be used to backfill pipeline trench, as fill material onsite, or disposed of in upland areas. Sediments deemed unsuitable for use or placement in upland areas would be disposed of appropriately in landfills approved for hazardous disposal (PEF 2009k). In addition, PEF has stated that residual water from dredging activities would be tested for compliance with NPDES and Florida standards for surface-water quality (Fla. Admin. Code 62-302) before being returned to the CFBC. Discharge piping running from the LNP site to the CREC discharge would run parallel along the northern CFBC berm, enter and exit CFBC water supported by anchor piers along both CFBC berms, and run south to CREC along an existing transmission-line corridor (PEF 2009a). Benthic habitat in the area proposed for discharge pipeline trenching is dominated by polychaete and oligochaete worms (CH2M HILL 2009b). Once pipeline installation is complete, these species may be able to colonize adjacent habitat and re-colonize original habitat. Motile invertebrates, fish, sea turtles, or manatees may swim into this portion of the CFBC, but they would be able to swim away or likely would avoid the area due to vibratory noise. Section 4.3.2.3 of this chapter discusses additional concerns related to building impacts on important species.

Transportation of large components for building LNP will include use of barging in the CFBC to the barge-unloading facility. Barge traffic could interact with aquatic organisms (e.g., sea turtles and manatees) within the CFBC.

Inglis Lock Bypass Channel

Intake and discharge piping would be placed over the Inglis Lock bypass channel along an existing bridge and would not be placed in this waterbody. Pipeline placement over this waterbody would follow BMPs associated with stream-crossing regulations related to minimization of sedimentation and bank erosion (PEF 2009i). No aquatic impacts are expected to occur with this activity.

CREC Discharge Canal

The LNP discharge pipeline (two 54-in. high-density polyethylene pipes, according to the conceptual design) would discharge directly into the CREC onsite discharge – a concrete-lined, open channel just downstream of the discharge culverts for Units 4 and 5. This 0.7-mi open discharge channel drains directly into the Gulf of Mexico. A headwall structure would be necessary to join the LNP discharge piping to the CREC discharge (PEF 2009e). No building activities related to LNP would be conducted beyond the western terminus of the LNP headwall structure less than one mile from the Gulf of Mexico. No aquatic impacts are expected to occur with this activity provided appropriate BMPs are utilized during the construction of the headwall structure.

4.3.2.2 Aquatic Resources – Transmission Lines

PEF would site the new 500- to 230-kV and 65-kV transmission lines in accordance with 29 Florida Statutes 403.501. In addition, PEF has committed to complying (PEF 2009a) with all applicable laws, regulations, and permit requirements and using good engineering and construction practices as required by FDEP (Fla. Admin. Code 62-17). PEF states that all work would be conducted in accordance with Federal and State permitting requirements for maintaining water quality and protecting natural resources, such as maintenance of a 15-ft or greater buffer of natural vegetation for installation near waterbodies (Citrus County 2006). PEF plans to leave a 25-ft buffer of existing vegetation with mature heights not exceeding 12 ft at locations where the transmission-line corridor crosses a navigable waterway (PEF 2008a). Permits required include a USACE Section 10 Rivers and Harbors Act Permit, FDEP ERP, FDEP and Southwest Water Management District dewatering permit, and a FDEP NPDES construction stormwater permit (PEF 2009a). County listings for threatened and endangered species have been identified for each delineated corridor. Although several threatened or endangered aquatic species are listed for Levy and Citrus Counties (as outlined in Section 2.4.2), the activities associated with placement of new lines would not require in-water installation activities. Therefore, the review team finds that impacts on aquatic resources due to transmission-line preparation and installation would be minor.

Beyond First Substation

County listings for threatened and endangered species have been identified for candidate corridors in Hernando, Hillsborough, Pinellas, and Polk Counties. The Suwannee cooter (*Pseudemys concinna suwanniensis*), a State species of concern, and the State and Federally endangered Florida manatee (*Trichechus manatus latirostris*) are the only listed aquatic species likely to occur in waterbodies associated with transmission-line corridors in these four counties.

Activities associated with placement of new lines would not require in-water installation activities. Therefore, the review team finds that impacts on aquatic resources due to transmission-line preparation beyond the first substation would be minor.

4.3.2.3 Aquatic Species and Habitats

Important Species and Habitats

This section describes the potential impacts on important aquatic species resulting from site preparation for the new units at the LNP site, barge slip, intake structures, discharge structures, and addition of transmission lines in existing corridors. The review team has determined that building impacts on aquatic resources would be limited to the CFBC and the CREC discharge canal, excluding the Gulf of Mexico at the point of discharge and beyond. The general life histories of these species are presented in Section 2.4.2. The NRC staff prepared biological assessments and an essential fish habitat assessment (see Appendix F) documenting the impacts on the Federally listed threatened and endangered terrestrial species described in the FWS and NMFS correspondence (FWS 2009e; NOAA 2008a, b) associated with building a new nuclear unit. The NRC staff's impact determinations from the biological assessments and essential fish habitat assessment are reiterated in this section.

<u>Commercial Species</u>

With the exception of the blue crab (*Callinectes sapidus*), all commercial fishery activities occur well offshore of the CFBC and CREC point of discharge into the Gulf of Mexico. Commercial blue crab pots were observed by the review team within the lower portion of the CFBC on two separate occasions, with some sighted near the proposed trenching site for the discharge piping. Installation and dredging activities in this area may disrupt commercial harvest success, but these impacts are assumed to be temporary and minor with the use of BMPs to minimize sedimentation, and typical seasonal abundance should resume after building activities are completed.

<u>Recreational Species</u>

Recreational angling occurs in the CFBC. Recreational angling also occurs in the vicinity of the CREC discharge canal, but is prohibited in the discharge canal. Building activities associated with the barge-unloading facility, intake structure, and discharge pipeline trenching may affect successful recreational angling in the vicinity of these activities due to avoidance by recreational species near any in-water work. These impacts are expected to be temporary and minor with the use of BMPs to minimize sedimentation and erosion to prevent degradation of water quality. It is expected that fish and crabs should resume use of the habitats within the CFBC after completion of building activities.

Essential Species

The presence of forage fish within the CFBC is summarized in Table 2-14. Building activities associated with the barge-unloading facility, intake structure, and discharge pipeline trenching may affect the presence or habitat use by these forage species in the vicinity of these activities due to noise avoidance by recreational species. However, these impacts are expected to be temporary and minor because fish should return to these areas within the CFBC after completion of building activities.

Rare Species

The speckled hind (*Epinephelus drummondhayi*) and the Warsaw grouper (*Epinephelus nigritus*) are both listed by NMFS as species of concern that are known to occur in inland waters of the Florida Gulf Coast. However, neither of these species was collected or observed within the CFBC, so any building-related impacts on these species are unlikely. Building activities within the CREC discharge canal would not occur outside the point of discharge of the canal into the Gulf of Mexico. Therefore, no building-related impacts are expected to occur.

Federally and State-Listed Species

As part of NRC's responsibilities under ESA Section 7, the staff has prepared a biological assessment documenting potential impacts on the Federally listed threatened or endangered aquatic and terrestrial species as a result of the site building activities at the LNP site. The biological assessment is provided in Appendix F and the findings and determinations are summarized in this section. The NRC staff has determined that no critical habitat occurs near any of the planned building areas.

Manatee – Federally Endangered

Manatees migrate to warmer waters in the winter near the coast, are known to occur in the CREC discharge canal particularly in the fall and winter (PEF 2008b), and have been sighted in the CFBC and Old Withlacoochee River (OWR, a remnant arm of the Withlacoochee River) throughout the year (CH2M HILL 2009c). Boating-speed restrictions are set by the FFWCC to limit the potential of boat and propeller strikes on manatees within the CFBC and the OWR (FFWCC 2002). Dredging activities likely would require work done from a vessel within the CFBC and must adhere to boating-speed regulations. To prevent impacts on manatees in the vicinity of building activities, as required by the FFWCC and USACE, PEF would comply (PEF 2009a) with the Standard Manatee Conditions for In-Water Work (FDEP 2009b) for building activities in the CFBC. These conditions include halting all building-related activities if manatees are spotted within a 50-ft radius of the activity. A wildlife spotter is required during all building-related activities.

While boating activities are not allowed within the CREC discharge canal, installation of discharge piping from the proposed LNP to the CREC may require in-canal activities. PEF has a Manatee Protection Plan approved by FDEP for minimization of hazards to manatees while performing in-water work, including avoidance of in-water work in the discharge canal from November 15 through March 31 when manatees use the warmer waters in this system as a refuge.

<u>Sea Turtles</u>

Adult, subadult, and juvenile loggerhead sea turtles (*Caretta caretta*) are known to occur in the area of the CREC and may enter the CREC discharge canal or the CFBC. Juvenile green turtles (*Chelonia mydas*) and juvenile and subadult Kemp's ridley turtles (*Lepidochelys kempii*) are also known to occur near the CREC discharge canal and may also enter the CFBC. Leatherback (*Dermochelys coriacea*) and hawksbill (*Eretmochelys imbricata*) sea turtles are rare off the coast of Levy and Citrus Counties and are not expected to occur near the dredging and installation activities associated with the proposed LNP. Sea turtles present in the CREC discharge canal or CFBC areas during building activities are likely to avoid disturbances and swim away. Sea turtles may be affected by barging traffic. The speed of the barges is low enough that turtles that come in contact with the barges or are entrained in the cavitations created by the moving barges would not be severely damaged (National Research Council 1990).

<u>Smalltooth Sawfish – Federally Endangered</u>

Although the spawning critical habitat for smalltooth sawfish (*Pristis pectinata*) is located along the southwestern coast of Florida, occurrence records indicate that juvenile sawfish are present near the CREC discharge and CFBC areas. However, adverse impacts are unlikely because these fish would avoid activities occurring in these areas.

<u>Gulf Sturgeon – Federally Endangered</u>

Gulf sturgeon (*Acipenser oxyrinchus desotoi*) were not collected in sampling efforts and are not likely to be encountered during building activities in the CFBC or CREC discharge canal because neither of these areas is critical habitat or preferred spawning areas. However, if individuals are present adverse impacts are unlikely because juvenile or adult fish could avoid activities occurring in these areas.

Aquatic Threatened and Endangered Species Summary

Based on threatened and endangered species surveys, historical records, life-history information, known threatened and endangered species locations, and information provided by PEF in its ER and responses to RAIs, the review team concludes that the impacts on aquatic

Federally listed threatened and endangered species from building activities on the LNP site would be minimal. A detailed account of the review team's assessment can be found in Appendix F.

Essential Fish Habitats

The evaluation of essential fish habitat for both the CFBC and CREC discharge canal includes a determination of the presence of Habitat Areas of Particular Concern (HAPC), as well as a site-specific assessment of essential fish habitat. HAPC are identified geographical areas that have elevated importance, provide important ecological functions, and are vulnerable to degradation. No HAPC occur in either waterbody or in associated Gulf of Mexico nearshore areas (NOAA 2004). Site-specific assessment of essential fish habitat associated with the CFBC and CREC discharge canal are presented in Appendix F. Appendix F provides the known distributions and records of Ecoregion 2 listed species and life stages and the potential ecological impacts of building activities on the species, their habitat, and their prey. Based upon the project building plans, the minimal short-term impacts associated with the dredging, and intake installation, the review team believes that adverse effects on essential fish habitat that could be affected by the building of the LNP would be minimal.

4.3.2.4 Aquatic Monitoring

PEF plans to perform building-related monitoring in the CFBC associated with installation of the cooling-water intake structure (CWIS) and with placement of the discharge piping. Both installation activities would result in displacement of benthic invertebrates and building-related monitoring is intended to assess changes in this community. To determine recovery of benthic communities at these two locations, sampling events are planned for 6 months prior to installation activities, 1 year after installation activities, and 3 years after installation. Sampling at each area would be conducted using a Ponar dredge along transects directly along the dredged area and 500 ft upstream and downstream of the CWIS and discharge piping locations (PEF 2009a).

During building activities, a biologist would be present to visually monitor for threatened and endangered species that may appear in the CFBC or CREC discharge areas (FDEP 2009b). Sea turtles and manatees might approach these areas, and their presence near the installation and dredging areas during activity may require a temporary halt of work (FDEP 2009b). PEF does not plan on any building-related monitoring of aquatic ecosystems during installation of the transmission lines. Because most of the new lines would follow existing corridors, no footings are planned for placement in waterbodies.

4.3.2.5 Potential Mitigation Measures for Aquatic Impacts

Impacts on aquatic resources are expected to be temporary and minor because fish and motile invertebrates likely avoid areas of building activities in the CFBC. Therefore, there are no plans for additional mitigation as a result of building activities.

4.3.2.6 Summary of Impacts on Aquatic Resources

Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities on the freshwater, estuarine, and marine aquatic biota and habitats, including impacts on aquatic threatened and endangered species and other important species onsite, offsite, and within the transmission-line corridors would be SMALL, and no additional mitigation measures are proposed at this time. The LWA rule (72 FR 57416) specifically indicates that transmission lines and heavy-haul roads are not included in the definition of construction. Based on the expectation that no NRC-authorized construction activities would affect freshwater, estuarine, and marine aquatic biota and habitats, the NRC staff concludes that the impacts on aquatic resources due to NRC-authorized construction activities would also be SMALL.

4.4 Socioeconomic Impacts

Construction and preconstruction activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of building-related activities and the construction workforce on the region. The review team reviewed the ER prepared by PEF and verified the data sources used in its preparation by examining cited references and independently confirming data in discussions with community members and public officials (NRC 2009). To verify data in the ER, the review team requested clarifications and additional information from PEF as needed. Unless otherwise specified in the sections below, the review team has drawn upon verified data from PEF (2009a, d, e, i, j). Where the review team used different analytical methods or additional information for its own analysis, the sections include explanatory discussions and citations for the additional sources.

Although the review team considered the entire region within the 50-mi radius of the LNP site when assessing socioeconomic impacts, because of expected commuter patterns, the distribution of residential communities in the area, and the nature of the likely socioeconomic impacts, the review team identified a primary Economic Impact Area (EIA) composed of the three counties that surround the site – Levy, Citrus, and Marion – as the area with the greatest potential for economic impacts.

4.4.1 Physical Impacts

Construction and preconstruction activities can cause temporary and localized physical impacts, such as noise, fugitive dust, air emissions, and visual aesthetic disturbances. Many of these impacts can be mitigated. All of the mitigation activities discussed below were identified by PEF in its ER (PEF 2009a). Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section discusses potential impacts on people, buildings, and roads from site-clearing and building activities. For more than a century, the LNP site has been used for forest plantation. Most of the LNP site would be preserved in its present condition with forest surrounding the industrial area. The closest residential properties are located 1.6 mi northwest and 1.7 mi west-southwest of the site. The nearest recreational resources are Goethe State Forest, the Marjorie Harris Carr Cross-Florida Greenway, Inglis Island Trail, Inglis Lock Recreation Area, and the CFBC (see Table 2-24). These recreational resources are located south and northeast of the site. PEF estimates the peak onsite workforce during the construction and preconstruction of LNP Units 1 and 2 to be 3300 workers (specific assumptions are discussed in the following sections), with less than the total number of workers present onsite at one time because of shift work.

4.4.1.1 Workers and the Local Public

This section discusses potential impacts of air emissions and noise on workers, nearby residents, and nearby users of recreational areas.

Fugitive dust and other air emissions would be generated by ground clearing, wind erosion, excavation, grading, cut-and-fill operations, a temporary concrete batch plant, and increased vehicular traffic. As discussed in Section 4.4.1.2 of the ER (PEF 2009a), Levy County is an attainment area for all criteria pollutants for which NAAQSs have been established (40 CFR 81.310). Ambient air quality would be affected by a temporary increase in fugitive particulate matter onsite and offsite along the pipeline and heavy-haul road and at the pump house and intake structure, and by emissions from construction equipment and vehicle exhaust. Emissions from construction equipment would include sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and volatile organic compounds (VOCs) as well as particulate matter. The impacts on offsite receptors would be limited by the vegetation buffer around the area of the site that would be cleared – with the exception of activities along offsite areas of the pipeline and heavy-haul road and at the pump house and intake structure.

BMPs and control measures would be used to limit the impacts of emissions. The concrete batch plant would be operated in compliance with FDEP regulations and would avoid emissions from trucks that otherwise would deliver concrete to the site. BMPs and control measures would include development and implementation of a fugitive dust-control plan, grading to promote drainage and minimize mud on vehicles, stabilization of ground surfaces as soon as practical after clearing (e.g., reseeding), wetting of bare ground and unpaved roadways during dry conditions, conducting any burning in accordance with applicable regulations and forest-fire-safety measures, and inspecting and servicing construction equipment regularly (PEF 2009a).

Noise associated with the use of substantial numbers of vehicles and equipment would be expected to raise background noise levels, principally during daytime hours. To limit onsite noise impacts, workers would use noise protection as required by the Occupational Safety and Health Administration (OSHA) when engaging in work subject to noise hazards. A noise analysis of the LNP project, conducted in March 2008 as part of the LNP's Site Certification Application to the State of Florida, indicated that during certain activities, such as pile driving, noise would be perceptible from the nearest offsite locations, i.e., the recreational resources and the nearest residences. The analysis found that noise levels associated with most building activities would be below the daytime noise limit under Levy County's Noise Ordinance (Levy County Code 50-349 2008) for residential, rural, and commercial districts. To limit noise impacts at offsite locations, PEF would develop and implement BMPs such as scheduling activities with high noise levels during daytime hours and maintenance of mufflers on engines (PEF 2009a).

People living near the LNP site or using the local recreation areas would not experience any building-activity-related noise or air quality impacts greater than those that would be considered an annoyance or nuisance because of their distance from the activities and the vegetation screening, both of which would limit exposure. Construction and preconstruction activities would be performed in compliance with Federal, State, and local regulations and site-specific permitting conditions, as well as the BMPs already mentioned. Consequently, the review team expects that air quality and noise impacts at the LNP site would be minimal, and no further mitigation would be warranted beyond what is identified in the ER.

4.4.1.2 Buildings

The LNP site is a greenfield site that has no onsite buildings. Construction and preconstruction activities would not affect any offsite buildings due their distance from the site.

4.4.1.3 Roads

Public roads, a private haul road, and barges would be used for the transport of materials and equipment. Roads within the vicinity of the LNP site would experience an increase in traffic at the beginning and the end of each shift (see Section 4.4.4.1). Commuter, delivery, and construction equipment traffic would be controlled by onsite speed limits. The access road from the west to the LNP site would be paved. Stabilizing and wetting unpaved roads and cleared areas onsite would be an established dust-control measure. Other measures would reduce the potential traffic noise and vehicle exhaust impacts generated by the transport of materials, equipment, and workers onsite and entering and leaving the LNP site. For these reasons, the review team determined that project-related physical impacts on roads within the vicinity of the site would be minimal, and additional mitigation would not be warranted.

4.4.1.4 Aesthetics

Most of the LNP site would be preserved in its present condition with forest surrounding most of the site. Vegetation and distance would screen construction and preconstruction activities from most offsite viewers, including the closest residences. Recreational users would be able to see the construction site from portions of Goethe State Forest near the north site boundary where vegetation would be cleared. Building activities would also be seen from portions of the Marjorie Harris Carr Cross-Florida Greenway, the Inglis Island Trail, the Inglis Lock Recreation Area, near the intake structure and pump house where there is no existing vegetation, and along transmission-line corridors or the pipeline corridor where vegetation would be cleared. Users of the local recreation areas may choose to avoid locations near the site. If so, this potential displacement would be a slight impact because other parts of these recreation areas would be available and unaffected by building activities and other recreational facilities farther away, but still within the region, would be available for use.

Long-term visual impacts would result from the building of some of the LNP components. The central industrial area, pipeline, intake structure, and pump house would be cleared, permanently replacing existing vegetation with maintained grass. While the central industrial area would be screened from offsite viewers by forest vegetation, other components would be visible. The area surrounding the site in the vicinity of the proposed pipeline, haul road, intake structure, and pump house presently includes some mixed development and visual intrusions on the forest/forested wetland landscape, such as roads, powerlines, commercial development, and land clearing along the CFBC (PEF 2009a). Additional clearing and structures would create minor aesthetics impacts in these areas. In places requiring the clearing of new transmission-line corridors, aesthetic impacts would be noticeable but not destabilizing depending upon the location of viewers and the nature of vegetation remaining between them and the corridors.

4.4.1.5 Summary of Physical Impacts

Based on the information provided by PEF (PEF 2009a), the review team's independent analysis, and taking into account the BMPs and mitigation measures identified, the review team concludes that the overall physical impacts of construction and preconstruction on workers and the local public, buildings, and aesthetics near the LNP site would be SMALL, although localized MODERATE impacts would be felt along newly cleared transmission-line corridors.

4.4.2 Demography

PEF (PEF 2009a) estimates the peak workforce during construction and preconstruction would be 3300 workers, with the peak workforce by year during this period estimated as follows[(a)]:

- 2012: 750 workers
- 2013: 1000 workers
- 2014: 1950 workers
- 2015: 3100 workers
- 2016: 3300 workers
- 2017: 2900 workers
- 2018: 1250 workers
- 2019: 100 workers.

PEF indicates that 140 operations engineers who would be working during the construction and preconstruction phases are included among these workers, about half of whom would be onsite at any time (PEF 2009d). The impacts associated with these operations workers during the construction and preconstruction phases are found in this chapter, and the underlying assumptions for their demographic effects are discussed in Section 5.4.

PEF assumes preconstruction would start with site preparation in 2012 or 2013, which would extend for 1.5 years (18 months). NRC-authorized construction activities on Unit 1 would then start, followed a year later by NRC-authorized construction activities on Unit 2. Construction on each unit would extend for about 3.5 years (42 months). Before starting commercial operation, each unit would undergo about 6 months of testing. PEF expects Unit 1 to begin commercial operation in 2018 or 2019 and Unit 2 to begin commercial operation in 2019 or 2020. PEF anticipates peak employment would occur in 2016 (PEF 2009a).

As indicated in Section 2.5.2.1, qualified workers exist in this region of Florida in many of the heavy-construction trade groups that would be needed for construction and preconstruction activities, but not in sufficient numbers or with all of the special skills that would be needed for the plant. Thus, workers from outside the EIA and region would be needed.

Based on PEF's estimates of phase duration and schedule, the review team assumes the following, for the purpose of this study:

- Site preparation would start in 2012, peak employment would be reached in 2016, Unit 1 would commence commercial operation in 2018, and Unit 2 would commence commercial operation in 2019.

(a) The review team understands that project scheduling is subject to change, and that actual years portrayed in this discussion may not be the actual years of construction. However, the review team believes the general sequence and the magnitude of the estimated work force are accurate.

- Fifty percent of the workers and their families would move their place of residence to the 50-mi region surrounding the LNP site.
- The place of residence for in-migrating workers and the distribution of indirect jobs they create within the EIA would be 20 percent in Levy County, 45 percent in Citrus County, 20 percent in Marion County, and 15 percent divided among the other 8 counties within 50 mi of the site.
- The average household size of the in-migrating workforce would be 2.49 persons (State of Florida average).
- The job of each worker migrating into the EIA would support the generation of an additional 0.6 indirect jobs in the EIA (BEA 2009).
- The indirect jobs created as a result of the LNP would be filled by people already residing in the region, some of whom would be unemployed without the project.
- At some point after the peak employment, 500 Unit 1 operations workers would begin arriving on the site. Additional operations workers for Unit 2 would arrive subsequently. The impacts from these operations workers are addressed in Section 5.4.

The review team projects that 4110 people (in-migrating construction workers and their families) would have moved into the region at peak employment (2016), 85 percent of whom would move into the EIA. An additional 244 in-migrating operations workers and their families would have moved into the region at peak employment, 80 percent into the EIA, for a total increase of 3689 people in-migrating into the EIA during the peak year (2016). These people would be distributed among Levy (859 at peak), Citrus (1935 at peak), and Marion (895 at peak) Counties. This increase would be approximately 0.61 percent of the entire EIA population projected for 2015 (Table 2-16) when the construction and preconstruction workforce is expected to be near its peak. The increase for Levy County is projected to be 1.85 percent, 1.20 percent for Citrus County, and 0.23 percent for Marion County. The review team assumes that the characteristics of the additional population are reasonably approximated by the characteristics of the current population shown in Tables 2-19, 2-20, and 2-21. The review team determined that the overall population increase would not be noticeable within the EIA.

4.4.3 Economic Impacts on the Community

This section evaluates the social and economic impacts of construction and preconstruction on the area within 50 mi of the LNP site, focusing primarily on the three counties of the EIA – Levy, Citrus, and Marion. The evaluation assesses the impacts and demands placed by the larger workforce on the surrounding region. Key assumptions relate to the number and value of new jobs and where jobholders would reside.

As indicated in Section 4.4.2, the assumption that 50 percent of the workforce would come from outside the region acknowledges the availability of some heavy-construction workers within the region and in the EIA. Historically, the area has experienced a relatively low unemployment rate. Therefore, since some workers would remain employed elsewhere in the region, and that some special skills for nuclear power plant production would not be present within the region demonstrates the demand for in-migrating workers. The review team determined that an assumption that 50 percent of the workforce would in-migrate is reasonable. The impacts of a different level of in-migration could be estimated by adjusting the impacts discussed below by the appropriate factor.

As indicated in Section 4.4.2, the review team assumed the place of residence for in-migrating workers within the EIA would be 20 percent in Levy County, 45 percent in Citrus County, and 20 percent in Marion County. Of the remaining 15 percent of in-migrating workers, the review team assumed that 7 percent would move into Alachua County and 2 percent (each) would move into Dixie, Gilchrist, Hernando, and Sumter Counties. Table 4-10 shows the expected distribution of in-migrating workers in the EIA at peak employment.

The review team's assumptions about the distribution of in-migrating workers differ from those PEF used in its ER. The review team determined that there was adequate housing capacity in each one of the counties in the region for the 1650 worker households expected at peak. Given this availability of housing, the review team assumed, based on experience at other construction sites, that workers would consider commute time, the quality of housing (including availability of rental units and space for motor homes), and, to some extent, access to amenities, such as shopping and healthcare, in selecting residence location. Local officials familiar with the area also provided input about the likely distribution of workers (NRC 2009).

Levy, Citrus, and Marion Counties offer a number of residential areas within a 40-minute driving time of the LNP site (see Table 2-28). In part because of development that followed construction of the CREC, Citrus County offers proportionally more housing and amenities than Levy and Marion Counties within the 40-minute driving time. Ocala (in Marion County) and Gainesville (in Alachua County) are larger cities with more amenities that would be accessible for occasional visits, but these would be expected to see relatively fewer in-migrant workers because they are a 50- to 70-minute commute from the site. The other counties also are at least 60 minutes away.

4.4.3.1 Economy

The impacts of the project during construction and preconstruction on the local and regional economy depend on the region's current and projected economy and population. For this analysis, the review team assumes that if a COL is issued, site clearing and building activities would begin in 2012 and end in 2018 for LNP Unit 1 and in 2019 for LNP Unit 2, with commercial operation beginning in 2018 for Unit 1 and 2019 for Unit 2.

Table 4-10. New Jobs at Peak Employment During Construction and Preconstruction Activities (Estimated 2016)

County	Percent of In-migrating Workers	Jobs Filled by In-migrating Workers	New Indirect Jobs Supported by Building Jobs	Total LNP-Related Jobs (in-migrant plus local)	Jobs Filled by In-migrating Operations Workers	New Indirect Jobs Supported by Operations Jobs	Grand Total of LNP-Related Jobs at Peak Employment	2005 Employ-ment	2005 Unemploy-ment	2005 Number of Un-employed
Levy	20	330	198	858	15	18	891	15,829	3.7%	614
Citrus	45	743	446	1931	34	41	2006	48,761	4.2%	2140
Marion	20	330	198	858	29	35	922	120,098	3.7%	4723
EIA	85	1403	842	3647	78	94	3819	184,688	3.9%	7477

Source: For employment and unemployment numbers: BLS 2005. Other numbers based on 3300 peak employment, BEA multipliers, and 50 percent in-migrant

EIA = economic impact area

When a new job is added to the economy, that new (direct) job supports the existence of other (indirect) jobs through the following process. Every new direct job in a given area – in this, case, a job building the LNP – stimulates spending on goods and services. This spending results in the economic need for a fraction of another indirect job, typically in the service industries. The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry employment and earnings. The review team obtained multipliers from the BEA for the EIA. The review team was advised that 1.6 was the expected employment multiplier for the construction and preconstruction jobs created by the LNP project, and 2.2 was the expected employment multiplier for the operations jobs created by the project. That is, 1.6 minus 1, or 0.6, jobs would be supported for every construction and preconstruction job, and 2.2 minus 1, or 1.2, jobs for every operations job in the EIA (BEA 2009). The BEA employment multiplier is applied to only in-migrating workers because the BEA model assumes the direct employment of workers that already live in the area would have no additional impact on employment. The review team cautions that use of these multipliers provides only rough indications of what may be expected as a result of new jobs.

Table 4-10 lists the total number of jobs created by the proposed project and filled by existing or in-migrating workers at the peak of construction employment in the EIA. It also provides 2005 employment and unemployment numbers for these counties as well. The table demonstrates that jobs related to building the LNP, both direct and indirect, would be a small percentage of total jobs in each county. These jobs would not noticeably affect unemployment numbers, with the exception of Levy County where the review team anticipates 546 new (direct plus indirect) jobs for people already in the county, which is close to the 616 unemployed in 2005. Thus, the review team finds that the project would have a minor beneficial impact on unemployment in Citrus and Marion Counties throughout the building phase, but would have a noticeable and beneficial impact on unemployment in Levy County for 2 to 3 years around the peak of employment.

PEF (2009d) found the average annual income for heavy-construction workers in Florida to be $45,919 in 2007 dollars, resulting in an estimated $151.5 million in annual salaries for the peak workforce, which includes $75.8 million annual salaries for the 1650 in-migrating workers at peak employment. The income for the peak workforce in the EIA would be $128.8 million in annual salaries, including $64.4 million for the 1403 in-migrating workers at peak employment. The income for the operations workers present during construction and preconstruction would be $12.3 million in the region, including $6.9 million for the in-migrating workers in the EIA at peak employment, assuming an $88,000 annual salary as discussed in Section 5.4.3.1. The review team believes these incomes represent a lower bound on the actual peak income because some of the skills required for nuclear power plant construction would command higher salaries than the highest salaries paid to other heavy-construction workers in Florida. In addition to the salaries of incoming construction, preconstruction, and operations workers, the review team estimated that the new indirect jobs would generate $34 million in salaries in the

EIA based on the estimated median household income for the EIA in 2005–2007 (USCB 2009a, b, c). The result would be almost $170 million in earnings in the EIA in the peak employment year. This is slightly less than 3 percent of the total 2005 earnings of more than $6 billion in the EIA (see Table G-5). For Levy County, the earnings of all construction, preconstruction, and operations workers and associated indirect jobs would total more than $39 million in the peak year – more than 10 percent of the 2005 earnings in the county. For Marion County, the earnings of all construction, preconstruction, and operations workers and associated indirect jobs would total more than $41 million in the peak year – slightly less than 1 percent of the 2005 earnings in the county. For Citrus County, the earnings of all construction, preconstruction, and operations workers and associated indirect jobs would total more than $89 million in the peak year – more than 6 percent of the 2005 earnings in the county.

The $45,919 average heavy-construction salary would be higher than the per capita income in the region (see Table 2-22). Even in counties such as Levy, Dixie, and Gilchrist, which have small workforces, the relatively small number of new heavy-construction jobs would have only a minor impact on per capita income, even in peak years.

The review team was advised by BEA that 1.5 was the expected earnings multiplier for construction work in the EIA, and 1.4 was the expected earnings multiplier for operations work in the EIA. The appropriate earnings multiplier is applied to all construction, preconstruction, and operations jobs because the BEA model assumes that wages are an infusion to the general economy. The review team applied the appropriate earnings multipliers to total annual construction, preconstruction, and operations salaries during the peak year in the EIA, resulting in an estimated $210 million in economic impact.

As shown in Table 10-4 and explained in Section 10.6.2.1, the review team estimates that the total cost of constructing the two LNP units would be $14.1 billion in 2008 dollars, including labor. PEF (2009a) assumes that 10 percent of its expenditures for materials would be within the region. This would amount to a maximum of $1.41 billion over 6 years, assuming all non-labor costs were for materials. This would average $235 million/year for materials and products from the region. The review team has determined that beneficial economic impacts could be experienced throughout the region. The increase in employment, earnings, and expenditures within Levy County during peak employment would have a noticeable beneficial effect. In the region as a whole, the increase in employment, earnings, and expenditures from direct and indirect jobs and purchases associated with building the LNP would have a minor beneficial effect on the economy of the region.

4.4.3.2 Commercial Fishing

As noted in Section 4.3.2.3, the review team found that with the exception of the blue crab, all commercial fishery activities occur well offshore of the CFBC and CREC point of discharge into the Gulf of Mexico and would not be affected by construction and preconstruction activities.

With regard to commercial blue crab, installation and dredging activities may disrupt commercial harvest success near barge sites and intake/outflow structures, but the review team expects these impacts will be minor and temporary with the use of BMPs.

4.4.3.3 Taxes

Primary tax revenues associated with construction and preconstruction of the LNP would be from property tax for the site and from sales and use taxes on goods and services purchased for construction and preconstruction and by workers. Corporate income taxes would not be applied until the units were in operation because PEF would not earn income until that time. Florida has no personal income tax.

Property Tax

As indicated in Section 2.5.2.2 and according to the Levy County tax collector (NRC 2009), tax on the LNP site is currently calculated by applying the current millage rate (15.78 in 2008) to the assessed value of the land after reducing the value by 90 percent for its agricultural exemption. The site currently is in multiple parcels that had not been merged as of December 2008. Before site preparation, PEF would continue to pay property tax according to the millage rate in effect for the site's assessed value reflecting the agricultural exemption. According to the Levy County assessor (NRC 2009), the county would remove the exemption for a parcel once site preparation begins and reassess it at the value of the property according to its future use (as a power plant). As PEF completes ancillary buildings, Levy County would reassess the value of the property to include the value of improvements. This could be done before either of the reactor buildings is completed. Levy County has not completed its appraisal process of land to be used as a power plant and is unable to advise what that value would be or how it would treat the assessment of improvements to the land. Consequently, the review team applied PEF's estimates of tax on the completed facilities.

The review team estimated a lower bound for tax revenues as follows. The Levy County tax assessor indicated that property in Levy County that is in agricultural use can receive up to a 90-percent exemption in its property tax. The LNP property is currently a forested plantation and would lose that exemption once construction begins on the proposed two units. Based upon the tax assessor information that a typical rural 125-ac parcel in 2008 had an assessed value of $219,000 ($1752 per acre), the review team estimated the LNP property in its current state would have an assessed value of $5,439,960 (NRC 2009). Applying the exemption to the entire LNP site, the tax payment to Levy County in 2008 would have been $8584 ($15.78 per $1000 for 10 percent of $5,439,960). Without the exemption, the increased annual revenue would be $77,259. Against Levy County's annual property tax revenue of $18 million, this would have a minimal effect.

Once the facility is substantially completed, Levy County would reassess property values and receive additional taxes that cannot be reasonably estimated at this time.

Once the project is completed, the value of the LNP property would be assessed at the value of construction cost, less the cost of pollution-control components, or approximately three-quarters of the total construction cost based on the historical costs of pollution-control components of the nuclear facility at CREC (PEF 2009m). The millage rate then in force would be applied to the new value; approximately $10.6 billion (see Section 10.6.2.1). The impact of these property tax revenues is discussed in Section 5.4.

Sales and Use Taxes

Many of the materials and items of equipment purchased for construction and preconstruction of the LNP would fall under Florida's steam-production and pollution-control exemptions (Florida Statutes, Sections 212.051(1) and 212.08(5)(c)) and would not generate sales or use tax revenue. Based on PEF's assumption that one-quarter of the estimated $234 million/year the project would spend in the region, or about $59 million, was not exempt, these purchases would generate a maximum of $3.5 million in sales tax revenue at 6 percent, with additional tax revenue up to 1 percent of $59 million, or about $590,000, for purchases in counties with a surtax (see Section 2.5.2.2). The added sales tax collected in the region for purchases would be less than 1 percent of the $712 million collected in 2004–2005 (see Table 2-23). In addition to surtax collected where applicable, each county would also receive its share of the one-half percent of the 6 percent base sales tax that is returned to counties by the State (about $17,500). These are a small proportion of the annual tax revenues in each of the counties in the EIA (see Table G-6 in Appendix G).

Nonexempt material and equipment bought outside the region or outside of Florida would also be subject to Florida sales or use taxes. Assuming that one-quarter of the 90 percent of materials bought outside the region or the State was non-exempt, this would be $529 million/year (one-quarter of 90 percent of $14.1 billion divided by 6 years). At 6 percent, this would generate an additional $32 million in sales and use tax revenue to the State. Combining in- and out-of-State purchases, the total annual sales and use tax revenue would be about $35.5 million or less than 2/100 of 1 percent of the $19.9 billion annual sales tax revenue collected in 2004–2005 (see Table 2-23).

Some of the earnings of workers and local residents who take the indirect jobs created by the multiplier effect would be spent on goods and services subject to sales tax. The review team estimated State sales tax revenue could increase by $3 million during the peak-employment year, assuming that about one-quarter of the $168 million total earnings in the EIA, or $42 million, is subject to sales tax. A maximum of 1 percent, (about $420,000) would be collected for county surtaxes. In addition, one-half percent (about $210,000) would be distributed in the

EIA and the local governments within it as their one-half-percent share of the 6-percent State tax. These are small percentages of the annual tax revenue in the EIA (see Table G-6 in Appendix G).

The review team concludes that construction and preconstruction of the LNP would have minor beneficial impacts on tax revenue in the EIA, the region, and State.

4.4.3.4 Summary of Economic Impacts on the Community

Based upon information provided by PEF in its ER and its own independent analysis, the review team determined that the economic impacts would be MODERATE and beneficial for Levy County and SMALL and beneficial for the rest of the EIA and the region. The review team also determined that the tax impacts from construction and preconstruction activities would be SMALL and beneficial for the entire EIA and region.

4.4.4 Infrastructure and Community Service Impacts

This section provides the estimated impacts on infrastructure and community services to include transportation, recreation, housing, public services, and education.

4.4.4.1 Transportation

Public roads and the CFBC would be used to transport construction materials and equipment to the LNP site. Material from a barge slip at the CFBC would be transported on a private heavy-haul road crossing CR-40 using standard 15-T trucks or, for certain modules, a special heavy-haul crawler.

The review team's analysis draws on a traffic study conducted by Kimley-Horn and Associates (Kimley-Horn or KH) to determine the impacts of construction, preconstruction, and operation of the LNP site on the surrounding road network (Kimley-Horn 2009). The KH study adopted Levy County's level of service (LOS) standards for roads in the county (Levy County 2008). The study considered the roads likely to be used to transport construction materials and equipment to the LNP site and to transport commuting workers to and from the site. KH used 24-hour traffic counts collected in July 2008 from a previous study (Kimley-Horn 2009), 2007 24-hour counts from the FDOT, and p.m. peak hour counts collected in November and December 2008 by KH staff.

In considering future traffic volumes for the peak employment, the KH study included projected traffic volumes from the planned Tarmac King Road Limestone Mine in the area and considered a 2.2-percent annual growth rate for existing traffic. In calculating traffic during a.m. and p.m. peaks, the study considered vehicles with construction workers (3300), operations workers

(500)[(a)], trucks and other construction vehicles (150), daily vendor trucks (5), and the commodity delivery-truck fleet (15). Assuming 1.8 workers per car, the KH study estimated 2262[(b)] project trips each way during peak employment – daily to and from the LNP site in two shifts (split 70/30 percent).

Using a model based on the population of communities within 35 mi of the site, the KH study found that construction-related traffic along US-19 would be split 30 percent to and from the north and 70 percent to and from the south. Of the 70-percent traffic from the south, most (65 of the 70 percent) would come to Crystal River and other points along US-19, while 5 of the 70 percent would use CR-40, with 4 percent to and from Inglis, Dunnellon, and other points to the east and 1 percent to and from the west. Of the 30-percent traffic from the north, 26 percent is projected to come to and from State Route 121 (SR-121), which traverses the city of Williston, northeast of the site, and 4 percent from farther north on US-19. Based on its own assessment of worker distribution, the review team determined that the study's assumption of a 70-30 split between north and south was consistent with the review team's expected traffic patterns and that the review team could rely on the traffic study's results.

Using the KH study's assumption of 1.8 workers per vehicle, at peak employment, 397 vehicles would come into the plant site from the north and 1025 vehicles from the south in the morning. Assuming two 12-hour shifts, 165 vehicles would leave to the north and 385 vehicles would leave to the south at the same time. In the evening, these traffic patterns would be reversed. In addition, the review team estimates that approximately 170 trucks would be entering and leaving the site each day, primarily during non-peak daytime hours.

Given these assumptions for traffic patterns, the KH study examined roadway segments in which LOS could be affected by project-related traffic on US-19, SR-121, and a short segment on US-41. The study also examined US-19 from SR-121 to the project site and CR-40 from US-19 to the heavy-haul road crossing. In addition, the study looked at the following intersections: US-19 with SR-121, US-19 with CR-40, US-19 with the site construction driveway, and CR-40 with the heavy-haul access road.

As shown in Table 4-11, the LOS on some road segments would be adversely affected by construction-related traffic. However, none of the segments would have an LOS performance that would fall below its LOS standard.

(a) Because PEF indicated that, at most, 70 operations workers would be onsite at any one time during the construction phase, the NRC staff used this reduced number in estimating traffic impacts. The review team assumed that all 70 operations workers would work the day shift and would follow the same north-south distribution in travel patterns.

(b) Review team calculated that 2281 would be the correct number of trips, using the KH study's assumptions.

Table 4-11. 2008 and Projected 2015 P.M. Peak-Hour Roadway LOS Conditions Near the LNP Site

Roadway	LOS Standard	2008 Roadway LOS (2-way)	2015 Roadway LOS (2-way)
US-19 SR-121 to LNP site	B	A	A
US-19 project site to CR-40	B	A	B
SR-121 US-19 to NW 27th Street	C	A	C
US-41 SE 80th Street/NW 27th Street to CR-328	C	B	C
CR-40 US-19 to heavy-haul driveway	C	C	C

Source: Kimley-Horn 2009.

Table 4-12 shows the LOS performance for each intersection resulting from the implementation of the following mitigation measures:

- extending turn lanes at the intersection of US-19 with CR-40,
- constructing turn lanes and adding a traffic signal at the intersection of US-19 with the construction driveway,
- constructing a turn lane and an approach lane at the intersection of CR-40 with the heavy-haul road, and
- using flagmen when a heavy-haul crawler is crossing CR-40.

Table 4-12. 2008 and Projected 2015 P.M. Peak-Hour Intersection LOS Conditions Near the LNP Site

Intersection	2008 Overall Intersection LOS		2008 Approach LOS			
	Standard	Construction Traffic	NB	SB	EB	WB
US-19 + SR-121 (unsignalized)	C	A	--	--	--	A
US-19 + CR-40 (unsignalized)	C	B	B	B	C	C
	2015 Overall Intersection LOS		**2015 Approach LOS**			
Intersection	**Standard**	**Construction Traffic**	**NB**	**SB**	**EB**	**WB**
US-19 + SR-121 (unsignalized)	C	B	--	--	--	B
US-19 + CR-40 (signalized)	C	B	B	B	C	C
US-19 + Construction Driveway (signalized)	B	C	B	B	--	D
CR-40 and Heavy-Haul Driveway (unsignalized)	C	B	B	B	--	--

Source: Kimley-Horn 2009.

The KH study concluded that, with the aforementioned modifications, only one intersection would fall below its LOS standard – US-19 with the construction driveway access to the LNP site, which would operate at LOS "C" only when the traffic signal is operating. The study notes that the traffic signal would be used only periodically while the units are being built. The review team presumes this would be at a.m. and p.m. shift changes, approximately 2 to 3 hours daily. Approaches from both north and south along US-19 would operate at an acceptable LOS ("B," the standard for US-19). Based on its review of the KH traffic study and assuming implementation of the study's mitigation recommendations, the review team anticipates minor impacts from construction and preconstruction of the LNP on the existing road network, with the exception of the intersection of US-19 and the construction driveway in Levy County where impacts would be noticeable and intermittent.

Potential impacts on navigation associated with this project are limited to the construction and operation of the barge slip and CWIS on the CFBC. Both facilities would be constructed within the upland banks of the CFBC. PEF would use the barge facility to transport large components of the proposed plant to the proposed heavy-haul road. Currently, use of this portion of the CFBC is by recreational boating and not by barges or other large commercial vessels. The review team determined that recreational boaters would be able to navigate around large barges and avoid the CWIS and associated currents with minor impacts on their activities.

4.4.4.2 Recreation

As described in Section 4.4.1.1, construction and preconstruction activities are not expected to have significant physical impacts on nearby recreational resources. Impacts, such as increased noise, increased traffic, impacts on air quality, and visual aesthetics, would be temporary and would decrease with distance from the source. Socioeconomic impacts on recreation may result from increased demand for or use of existing and planned resources and from the physical impacts mentioned above. The increase in demand on existing/planned resources would result from usage by the increased population (4110 workers and their families, as discussed in Section 4.4.2).

Recreation areas closest to the LNP that could be affected include Goethe State Forest, the Marjorie Harris Carr Cross-Florida Greenway, and the CFBC. These resources may experience an increase in use by construction workers and their families that migrate into the area. Goethe State Forest, which allows hunting, may experience an increase in demand from sport hunters who move into the area. Goethe State Forest has not reached hunter quotas and would be able to accommodate additional hunters in the area. Further, both Ocala National Forest and Withlacoochee State Forest offer hunting and are located within the region. The review team does not expect workers and their families to engage in subsistence hunting or fishing.

As summarized in Table 2-24 and Table 2-25, recreational resources within the region would accommodate the increased population and associated increased demand on these resources that would occur during construction and preconstruction. The State parks, State forests, and a greenway within the region have the capacity to accommodate 22,059 users on a given day, and current use is only 7346 users per day, or an average usage rate of about 25 percent. Crystal River Preserve State Park, Fanning Springs State Park, Withlacoochee State Forest, and Ocala National Forest offer horse use, hunting, fishing, water sports, hiking/bicycling trails, and other recreational opportunities and have sufficient capacity to accommodate the in-migrating workers and their families. The region has sufficient capacity to accommodate any displaced users at surrounding parks and recreational areas if such users choose to avoid certain recreational resources located near the LNP during its construction.

The review team determined that impacts on recreational facilities and on the quality of the recreational experience during construction and preconstruction would be minor.

4.4.4.3 Housing

The assumptions underlying the review team's estimated in-migration of workers were established in Section 4.4.3. Half of the 3300-person workforce (1650 workers) would move into the region; 1403 (85 percent) of them would move into the EIA. The review team also assumed all of the in-migrating workers would relocate to the region temporarily, moving out of the area when construction and preconstruction ends. In-migrating workers may choose to buy available vacant housing; rent; or stay in local hotels, motels, rooms, or campground/recreational vehicle (RV) areas.

PEF gathered data from the U.S. Census Bureau (USCB) about the capacity of the housing market to absorb the construction workers and their families that are expected to move into the region. Table 4-13 lists the available housing, including camping, mobile homes, and public lodging units in the region. As indicated by the table, the EIA has 78,889 housing units for rent or purchase; 22,769 mobile homes; 21,855 RV/camping units; and 16,056 public lodging units for a total of 139,569 units available. These housing levels are enough to provide the entire in-migrating workforce with living quarters.

Because of the availability of adequate housing, the review team expects commute time would be a major factor in a worker's selection of residence location. As described in Section 2.5.2.5 and shown in Table 4-13, the workforce would find more housing options in Citrus and Marion Counties than in Levy County, which is more rural in nature and has fewer amenities. It is expected that 45 percent of in-migrating construction and preconstruction workers would settle in Citrus County due to the combination of available housing and amenities for their families near the LNP site. Twenty percent would settle in Levy County, and another 20 percent would settle in Marion County. A check of properties listed on the commercial "Realtor.com" website in early 2008 found, an estimated 1888 permanent housing units available within the cities of Williston, Dunnellon, Crystal River, and Yankeetown (PEF 2009a). Although Dunnellon,

Table 4-13. Regional Housing and Residential Distribution for In-Migrating Construction Workers

County	Spatial Percent of Region	Permanent Housing	Owner-Occupied Housing	Housing Units Available to Rent or Purchase	RV/ Camping Capacity	2005–2006 Mobile Homes	Public Lodging Units	Total Units Available to Workers	Percent of Total Regional Units	Allocated Workers at Peak Employment[a]
Levy	20	16,570	11,591	4979	1752	1303	936	8970	3	330 or 20%
Citrus	11	73,609	51,176	22,433	6008	5829	2269	36,539	13	743 or 45%
Marion	24	152,858	101,381	51,477	14,095	15,637	12,851	94,060	32	330 or 20%
Alachua	12	106,746	51,942	54,804	3244	3545	31,771	93,364	32	116 or 7%
Dixie	6	7363	4498	2865	294	239	187	3585	1	33 or 2%
Gilchrist	4	5906	4331	1575	244	741	130	2690	1	33 or 2%
Hernando	9	77,423	56,709	20,714	5310	5823	2968	34,815	12	33 or 2%
Sumter	8	25,195	17,972	7223	5445	2577	1859	17,104	6	33 or 2%
Total		**465,670**	**299,600**	**166,070**	**36,392**	**35,694**	**52,591**	**291,127**	**--**	**1650 or 100%**

Source: PEF 2008b, using data from Florida Geographic Data Library on mobile homes and RV parks; USCB's "American Factfinder Florida;" and Bureau of Economic and Business Research, "Florida Statistical Abstracts 2007."
(a) Reflects in-migration of 50 percent of 3300 peak construction and preconstruction workforce.
Shaded cells indicate counties within the EIA.

portions of Crystal River, Inverness, Inglis, and Yankeetown have neighborhoods with large, well-established residences, most housing is modest, with many mobile homes and RV parks. Small residential areas and trailer/RV parks are common along CR-40 east of Inglis (NRC 2009).

The boom-and-bust nature of large-scale construction projects aggravates the housing impacts in local communities. The typical pattern begins when in-migrating workers and their families, along with local residents with enhanced economic resources because of project- and worker-related jobs and expenditures, increase the demand for housing. Increased demand creates upward pressure on both the housing supply and prices in the local area. When construction ends, most in-migrating workers leave and local indirect jobs are also lost. The presence of a considerable construction workforce that already lives locally, experience with seasonal population change and rapid growth, and the presence of zoning and land use development plans will all help prevent adverse impacts. Finally, the review team believes that although recent economic events have depressed the national and state economy, this economic downturn is temporary and current long-term growth projects are still reasonable.

Based on the information provided by PEF, interviews with local officials, and its own independent review, the review team expects there would be minimal impacts on the availability of housing from construction and preconstruction of the LNP in the EIA and the region.

4.4.4.4 Public Services

This section describes the expected impacts of construction and preconstruction at the LNP site on water supply and waste treatment, and police, fire-protection, emergency, and medical services in the region.

Water-Supply Facilities

A discussion of construction- and preconstruction-related water requirements and associated impacts is presented in Section 4.2. The water-supply wells for LNP's raw-water system (RWS) would tap into the freshwater aquifer at the site. The RWS would provide potable water, demineralized water treatment, and water for the fire-protection system. Water for the workforce present on the site prior to completion of the RWS would be trucked in until the potable-water system is operational (PEF 2009a). Therefore, the review team determined that water usage by the workforce while onsite would not affect municipal water supplies.

The review team calculated the increase in demand for residential water based on population projections for the EIA for 2015 and using a per capita demand of 150 gpd (Levy County's assumed value, Marion County's LOS standard, and a mid-value of the range of rates reported for Citrus County as discussed in Section 2.5.2.6). The demand for residential water within the EIA would increase by 0.524 Mgd of potable water during peak employment due to the in-migrating construction and preconstruction workers and their families. This increase, slightly more than a one-half percent increase over projected water demand in the EIA without the in-migrants, would be spread proportionally among the EIA's counties according to the distribution of workers discussed in Section 4.4.2. It would be 0.123 Mgd or a 1.8 percent increase in Levy County, 0.278 Mgd or a 1.1 percent increase in Citrus County, and 0.123 Mgd or a 0.21 percent increase in Marion County. The total water demand (including agricultural and industrial uses) projected for the EIA is 140 Mgd based on the county projections provided in Section 2.5.2.6. The added residential demand of 0.524 Mgd would be less than 0.4 percent of this total. The workforce is expected to settle into existing homes or camping/RV areas within the EIA that would already have access to water. New home construction for in-migrating workers, although unlikely, would have to be approved by local municipalities and permitting agencies if new water/wastewater infrastructure is needed. Given the small increase in demand that would result from the construction workers and their families that move into the area and requirements imposed by local municipalities and permitting agencies to demonstrate sufficient water capacity before allowing new construction, the review team has determined that impacts on water supply in the EIA would be minimal, and mitigation would not be warranted.

Wastewater-Treatment Facilities

The review team calculated the increase in wastewater treatment that would be required in the EIA during peak employment due to in-migrating workers and their families plus workers onsite. Using an average of 110 gpd (Marion County's LOS standard, highest among those reported in Section 2.5.2.6) for in-migrating workers and their families, 55 gpd for two shifts of workers onsite, and based on 2015 population projections from Table 2-16, the wastewater-treatment needs would be 0.475 Mgd. Compared to the needs projected for EIA populations in 2015, this would be slightly more than a 0.7 percent increase within the EIA, distributed as a 3.5-percent increase in Levy County, 1.1 percent increase in Citrus County, and a 0.21 percent increase in Marion County, to support the in-migrating workers and their families and workers onsite. The workforce is expected to settle into existing homes or camping/RV areas within the EIA that would already have wastewater infrastructure. New construction, although unlikely as a result of the construction workforce, would have to be approved by local municipalities and permitting agencies if new water/wastewater infrastructure is needed. Given the small increase in demand that would result from the construction workers and their families that move into the area and requirements imposed by local municipalities and permitting agencies to demonstrate sufficient wastewater-treatment capacity before allowing new construction, the review team has determined that construction- and preconstruction-related impacts on wastewater-treatment capacity in the EIA would be minimal and mitigation would not be warranted.

Police, Fire-Protection, Emergency Services, and Medical Services

As indicated in Section 4.4.2, the review team projects that 85 percent of in-migrating construction workers and their families would settle within the EIA, resulting in 1850 new residents in Citrus County, 822 in Levy County, and another 822 in Marion County at peak employment (fewer in earlier and later years). The additional population amounts to slightly more than a one-half-percent increase in Levy, Citrus, and Marion Counties over 2015 projections. Because it is unlikely that many new houses would be built for in-migrating construction workers, an increased load for fire-protection services would not be expected. This temporary population increase would potentially add to the workload for police and emergency services and increase the number of users of local medical facilities, although such small numbers should not noticeably affect performance except in localities where services are currently near or over capacity, as discussed below.

Locally, for Inglis police and emergency services, the review team anticipates a noticeable impact. Local Inglis services are structured currently only to serve the residential town itself. Because of its location close to the LNP site (at the junction of two commuter routes), Inglis is likely to see more impacts of commuter traffic in addition to some increase in population. Likewise, the review team anticipates noticeable impacts on Dunnellon police and emergency services, because police services already are at capacity and the community is expected to attract a number of the workers who settle in Marion County.

The review team expects no noticeable impact on fire-protection services in Marion and Citrus Counties because they have excess capacity and occupancy of new construction is not expected. Although the population increase in Levy County would be small and not result in new construction, the review team expects that even a small increase would cause a noticeable impact on Levy County fire-protection services because capacity is already inadequate.

Given the proximity to large regional medical centers and the current 16-percent vacancy rate in the region's hospitals, the review team expects a minor impact on access to medical care in the EIA and region. The increase in demand represented by a population increase of 0.3 percent should require only a small part of those vacancies.

4.4.4.5 Education

Construction and preconstruction of the LNP is expected to bring 1650 in-migrating workers to the region at the peak of employment in 2016. Many of these workers would be in the area for only a year or two (PEF 2009d). As indicated in Section 4.4.2, the review team projects that 85 percent of in-migrating construction workers and their families would settle within the EIA, resulting in 743 new households in Citrus County, 330 in Levy County, and another 330 in Marion County. The review team used county school district estimates of students per household from Table 2-35 to calculate the added students attributable to in-migrating construction worker households, as indicated in Table 4-14. The addition of 432 students would be a small number compared to the existing rolls in the EIA (approximately 66,000 students in 2007–2008, as shown in Section 2.5.2.7).

Table 4-14. Expected Number of Students from In-Migrating Construction Worker Households at Peak

	Elementary School Students	Middle School Students	High School Students	Total Students
Levy County	67	35	37	139
Citrus County	85	45	51	185
Marion County	52	26	30	108
EIA	204	105	119	432

As indicated in Section 2.5.2.7, there are capacity issues in Levy County schools, including Yankeetown School closest to the LNP site, and in Marion County schools, including Dunnellon High School and the elementary school closest to the LNP site. Citrus County, which would receive the largest number of new students, has minor capacity issues and offers some newer housing developments that would offer housing options to in-migrating workers. Because the State of Florida mandates that new development cannot be approved without appropriate accommodations for school-age children, the review team assumes that school capacity would be available for these locations.

Because it takes up to 3 years to construct a new school, schools within the EIA accommodate new growth by using mobile classrooms. School district officials surmised that the children accompanying the construction workforce would be accommodated through excess capacity in the districts and, if needed, use of mobile classrooms at schools lacking capacity (NRC 2009).

The review team concludes that impacts on public schools in the EIA would be minor, with noticeable impacts for 1 to 2 years during peak employment in schools serving Inglis, Yankeetown, and Dunnellon.

4.4.4.6 Summary of Infrastructure and Community Service Impacts

The review team determined impacts on all infrastructure and community services would be SMALL with the exception of the following larger impacts during peak employment years; MODERATE intermittent transportation impacts at the intersection of the access road from US-19 to the site; MODERATE impacts on Inglis and Dunnellon police and emergency services and Levy County fire-protection services; and MODERATE impacts on schools serving Inglis, Yankeetown, and Dunnellon.

4.4.5 Summary of Socioeconomic Impacts

The review team found physical, demographic, economic, infrastructure, and community service impacts of construction and preconstruction of the LNP generally would be SMALL. The review team identified MODERATE short-term beneficial employment impacts in Levy County and MODERATE short-term adverse impacts on police, emergency service, fire protection, and schools in specific local communities during peak employment years. MODERATE aesthetic impacts would be felt along newly cleared transmission-line corridors.

Based on the aforementioned conclusions and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, with the exceptions discussed below. The NRC staff concluded that no further mitigation would be warranted for categories with SMALL impacts.

The review team's finding of MODERATE adverse impacts was based on the review team's finding that specific community public services were either at capacity or otherwise limited. Consequently, any increase in demand for services would result in a noticeable impact. Therefore, the NRC staff concludes that the impacts of NRC-authorized construction activities would include MODERATE impacts on Inglis and Dunnellon police and emergency services and Levy County fire-protection services and MODERATE impacts on schools serving Inglis, Yankeetown, and Dunnellon during peak employment years.

To determine the portion of this impact attributable to NRC-authorized construction activities, the NRC staff assumed, based on PEF's estimated ratio of preconstruction-to-construction impacts, that 35 percent of the impact would be due to NRC-authorized activities. Although impacts from some NRC-related activities would be noticeable, NRC determined that additional mitigation measures would not be warranted given their temporary nature.

4.5 Environmental Justice Impacts

The review team reviewed PEF's ER and verified the data sources used in its preparation by examining cited references and independently confirming data in discussions with community members and public officials, and personal visits to the region (NRC 2009). To verify data in the ER, the review team requested clarifications and additional information from PEF as needed. Unless otherwise specified in the sections below, the review team has drawn upon verified data from PEF (2009a, d, e, i, j). Where the review team used different analytical methods or additional information for its own analysis, the sections include explanatory discussions and citations for those sources.

The review team evaluated whether the impact on minority and low-income populations at the census blocks identified in Section 2.6 could experience a disproportionately high and adverse effect from the potential impacts of construction and preconstruction of LNP Units 1 and 2. To perform this assessment, the review team (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for populations within the identified census blocks and populations not identified with particular census block groups, and (3) determined whether or not there were any unique characteristics or practices among the minority or low-income populations identified that would result in a disproportionately high and adverse impact on minority or low-income people within each census block. As discussed in Section 2.6.2, the review team found only one unique characteristic with the potential for such impacts: an exceptional dependence on subsistence resources.

To perform this assessment, the review team followed the methodology described in Section 2.6.1. In the context of construction and preconstruction activities at the PEF site, the review team considered the questions outlined in Section 2.6.1. For all three health-related questions, the review team determined through literature searches and consultations with NRC staff health experts that the level of environmental emissions projected is well below the protection levels established by NRC and EPA regulations and cannot impose a different effect on different segments of the population, including minority or low-income populations.

4.5.1 Physical and Socioeconomic Impacts

As shown in Figure 2-26, all census block groups with minority and low-income populations that meet the criteria discussed in Section 2.6 are located 10 mi or farther away from the LNP site. The closest minority populations (both aggregate and African-American) are in Citrus County between Citrus Springs and Dunnellon, approximately 10 mi from the site. The closest low-income populations, near Otter Creek in Levy County, are almost 20 mi from the site. There are concentrations of block groups with African-American populations around the communities of Otter Creek, Usher, Chiefland, and Williston in Levy County between 20 and 30 mi from the site; around Ocala in Marion County, about 30 mi from the site; around Gainesville in Alachua County, about 45 mi from the site; and in the northwest corner of Sumter County, between 20 and 30 mi from the site. (These are linear distances from the LNP site center; driving distances to all communities are greater.) Some block groups with low-income populations of interest overlap with African-American populations of interest around Otter Creek, Usher, and Chiefland in Levy County and around Ocala (Marion County) and Gainesville (Alachua County).

The review team determined that there would be no disproportionately high and adverse physical impacts on minority or low-income people within the identified census blocks. Distance from the site and intervening vegetation would mitigate physical impacts of construction and preconstruction on soil, water, noise, and air such that they would be minimal for all populations, including the minority and low-income populations closest to the site.

The review team reviewed socioeconomic impacts discussed in Section 4.4 to evaluate whether any construction- and preconstruction-related activities could have a disproportionately high and adverse effect on minority or low-income populations. The review team identified short-term MODERATE impacts on education, police, and emergency services in the area of Dunnellon because the Dunnellon high school, elementary school, and police department are at capacity. These impacts would extend to the African-American population in the census block group between Dunnellon and Citrus Springs to the extent that they use these Dunnellon and Marion

County services. The review team also identified short-term MODERATE impacts on fire protection in Levy County because of the current lack of capacity. These impacts might extend to the African-American and low-income populations around Williston and Otter Creek-Chiefland-Usher in Levy County. The review team also found MODERATE traffic impacts on US-19 at the intersection with the site access road for 2 to 3 hours daily during construction and preconstruction. These impacts would extend to any minority or low-income users of the highway. As discussed in Section 2.6.2, the review team did not identify any evidence of unique characteristics or practices in minority or low-income communities that may result in socioeconomic impacts that differ from those on the general population. Therefore, the review team found no evidence that adverse impacts on the minority and low-income populations in these instances would be disproportionately greater than to other populations also affected.

Based on the above analysis, the review team determined that the environmental justice impacts from physical and socioeconomic sources would be minor.

4.5.2 Health Impacts

For health-related considerations, the review team determined through literature searches and consultations with NRC staff health physics experts that the expected building-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and therefore cannot impose a disproportionately high and adverse radiological health effect on minority or low-income populations.

Section 4.9 assesses the radiological doses to construction workers after fuel loading for Unit 1 and concludes that the doses would be within NRC and EPA dose standards. Section 4.9 further concludes that radiological health impacts on the construction workers for proposed Units 1 and 2 would be SMALL. Therefore, there would be no disproportionately high and adverse impact on low-income or minority construction workers. From the review team's investigation, no offsite project-related potential pathways to adverse health impacts were found to occur in excess of the safe levels stipulated by general health and safety standards. Therefore, the review team concludes that there would be no radiological health-related impacts on offsite minority and low-income populations.

Where there are potential offsite nonradiological health effects, the review team did not identify any studies, reports, or anecdotal evidence that would indicate any environmental pathway that would physiologically affect minority or low-income populations differently from other segments of the general population during construction and preconstruction. Moreover, the review team's regional outreach provided no indication of any unique characteristics or practices among minority or low-income populations in the region that could lead to disproportionately high and adverse nonradiological health impacts. No impacts would be expected on the migrant farm worker populations identified in Section 2.6.4, even if they were employed near the LNP site.

Any increase in traffic accidents is unlikely to have a disproportionate impact on any particular demographic group in the region. The roads nearest the plant would be more crowded and can expect more traffic accidents, but these increases are likely to be located on the principal commuting routes, which are not located in the census block groups with populations of interest. There is no information to suggest that nearby minority or low-income communities would be disproportionately vulnerable to hazards while on the road. Furthermore, in examining communities of minority or low-income people, the review team did not identify any such community that would be affected disproportionately by nonradiological health items. Therefore, nonradiological health effects would not have a disproportionately high and adverse impact on minority or low-income populations, and the environmental justice impact would therefore be minor.

4.5.3 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations with unique characteristics, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements or high-density concentrations of minority populations.

4.5.3.1 Subsistence

As discussed in Section 2.6.2, some subsistence hunting and fishing reportedly take place in the region, but specific locations and quantities are not known. The review team considered that subsistence fisherman might use some of the areas affected by construction and preconstruction activities. As presented in Section 4.3.2.3, fish and shellfish harvesting near the site may be temporarily affected by increased turbidity due to construction and preconstruction activities. This may temporarily affect current subsistence catch rates of shellfish and finfish to the extent that they are occurring near the site, but the turbidity is not likely to alter fishing habits or harvest because fish and motile crustaceans present in the area during construction and preconstruction activities would avoid the area during active construction and preconstruction activities or would actively feed on suspended organisms during dredging operations and are unlikely to be adversely affected by the construction and preconstruction activities. The review team also considered that subsistence hunters might use some of the areas affected by construction and preconstruction activities. Bag rates of game in these areas may be temporarily affected because game in Goethe State Forest and other properties near the LNP site boundary may avoid the area during active construction and preconstruction, but the game populations are unlikely to be directly affected by the activities. Subsistence fishers and hunters, like recreational fishers and hunters, may choose to move to locations away from construction and preconstruction effects, but there are other locations available nearby, as indicated in Section 4.4.4.2. Consequently, the review team concludes that there would be minimal impacts on minority and low-income populations that can be linked to the construction and preconstruction of the LNP.

4.5.3.2 High-Density Communities

As discussed in Section 2.6.2, the review team determined that there are no high-density communities within the vicinity of the LNP site or along any pathway that might lead to disproportionately high and adverse effects.

4.5.4 Summary of Environmental Justice Impacts

The review team expects the physical impacts of plant construction and preconstruction on all populations in the region, including minority and low-income populations, would be SMALL because of their distance from the site. The adverse socioeconomic impacts on minority and low-income populations are also expected to be in proportion with the impacts discussed in Section 4.4 and, therefore, would be SMALL for most elements and MODERATE for education, police, emergency services, fire protection, transportation, and aesthetics in certain locations. In these locations, there is no evidence that effects would be disproportionately high and adverse on minority or low-income populations or to communities with unique characteristics. Based on the preceding analysis and because NRC-authorized construction activities represent only a part of the analyzed activities, the review team concludes that there are no disproportionately high and adverse impacts on minority and low-income populations resulting from construction and preconstruction of LNP, and environmental justice impacts would be SMALL.

4.6 Historic and Cultural Resources Impacts

NEPA requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA) also requires Federal agencies to consider impacts on those resources if they are eligible for listing in the National Register of Historic Places (NRHP or National Register; such resources are referred to as “Historic Properties” in the NHPA). As outlined in 36 CFR 800.8 (c), “Coordination with the National Environmental Policy Act of 1969,” the NRC is coordinating compliance with NHPA Section 106 in fulfilling its responsibilities under NEPA.

Construction and preconstruction of new nuclear power plants can affect either known or undiscovered cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and USACE are required to make a reasonable and good faith effort to identify historic properties in the Area of Potential Effect (APE) and, if such properties are present, determine whether significant impacts are likely to occur. Identification of historic properties is to occur in consultation with the State Historic Preservation Office (SHPO), Native American Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no important resources (i.e., places eligible for listing in the National Register or meeting the NEPA definition of important) are present or affected, the NRC and USACE are still required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC and USACE are required to assess and resolve any adverse effects of the undertaking.

For a description of the historic and cultural information on the LNP site, see Section 2.7. In 2008, PEF conducted a Phase 1 archaeological and architectural resources survey of the direct and indirect effects APEs. PEF concluded that there are no NRHP-eligible archaeological sites, above-ground resources, or traditional cultural properties located within the direct effects APE and the indirect effects APE. Because no archaeological or other resources were determined eligible, PEF made a determination of “no historic properties affected,” and the Florida SHPO concurred with this determination (Florida SHPO 2008a). During the site visit in December 2008, the NRC staff reviewed the documentation used by PEF to prepare the cultural resources section of the ER. The review team did not identify any important cultural resources that would be affected directly or indirectly by construction and preconstruction of LNP Units 1 and 2.

Tarmac America, LLC is currently pursuing a Section 404 DA permit to mine limestone in Levy County at the Tarmac King Road Limestone Mine. Because of its proximity to the LNP site, the review team is considering the proposed Tarmac King Road Limestone Mine as a surrogate for analyzing impacts of fill material at the LNP site. Development of the mine has the potential to affect cultural and historic resources. These impacts will be addressed in the Tarmac King Road Limestone Mine EIS. Since fill for LNP would be a small portion of the material mined at the Tarmac mine, if that mine was chosen to provide fill, only a portion of the impact of the mine would be considered directly attributable to the LNP project.

For transmission lines beyond the areas already mentioned, PEF has completed desktop cultural resources investigations. The transmission-line corridor from the proposed LNP to Central Florida South substation (commonly call the LCFS) contains one NRHP-eligible site (8SM128) and two sites having confirmed or potential human remains (8SM10 and 8SM84). Site 8SM128 is a site with both historic and prehistoric components. According to PEF (2009a), “These sites will be avoided to the maximum extent practicable during corridor selection and structure placement as described in ER Subsection 9.4.3. If avoidance of these three resources is not feasible, then appropriate minimization or mitigation measures will be developed in coordination with the SHPO.” Once transmission-line rights-of-way within the corridors have been finalized, PEF has agreed to complete comprehensive Phase I surveys prior to construction activities (PEF 2009a). In addition, PEF has committed to work in consultation with the Florida SHPO (PEF 2009b). In addition, FDEP conditions of certification included a condition in the LNP site certification requiring PEF to conduct surveys of sensitive cultural resource areas and, if practicable, avoid National Register-eligible sites, or mitigate through archaeological salvage operations or other methods acceptable to the Florida Division of

Historical Resources (FDEP 2010a). PEF would also be required to stop work immediately and notify the Division of Historical Resources if historical or archaeological artifacts are discovered (FDEP 2010a).

PEF has procedures in place for informing construction managers and workers to stop work if cultural materials or human remains are inadvertently discovered during construction and to notify staff within the appropriate Environmental Support Organization (ESO) (PEF 2009a). All work would be halted while the permitting specialist from within the ESO consults with the Florida SHPO. Any land-disturbing activity that affects a cultural resource would require a cultural resource assessment. In addition, if any area proposed for disturbance by construction is near known cultural resources, the appropriate staff within the ESO should be notified (PEF 2008c).

For the purposes of NHPA Section 106 consultation, based on (1) no known historic properties within the APEs, (2) the review team's cultural resource analysis and consultation, (3) the PEF commitment to follow its procedures if ground-disturbing activities discover historic or cultural resources, and (4) the PEF consultation with the Florida SHPO that concluded a finding of no historic properties affected (Florida SHPO 2008b), the review team concludes a finding of no historic properties affected (36 CFR Section 800.4(d)(1)).

For the purposes of NHPA 106 consultation, the USACE has considered the impacts related to the installation of the proposed transmission lines and other offsite activities. Because the cultural resource studies for the transmission lines are not completed, the USACE cannot provide an official finding of effect conclusion for this portion of the project. PEF has committed to working in consultation with the Florida SHPO to conduct comprehensive Phase I surveys prior to construction activities (PEF 2008c). As described above, the State of Florida included a condition in the LNP site certification regarding cultural resources.

For the purposes of the review team's NEPA analysis, based on (1) no known significant cultural resources within the APEs, (2) the review team's cultural resource analysis and consultation, (3) PEF's commitment to follow its procedures should ground-disturbing activities discover historic or cultural resources, (4) PEF's consultation with the Florida SHPO that concluded a finding of no historic properties affected (Florida SHPO 2008a), (5) the LCFS corridor containing one NRHP-eligible site (8SM128) and two sites with confirmed or potential human remains (8SM10 and 8SM84), and (6) the undetermined exact location of the transmission lines which could avoid known cultural resources during the siting process, the review team concludes that the potential impacts on historic and cultural resources during construction and preconstruction would be SMALL. If building activities within the transmission-line corridors result in significant alterations to the known cultural resources, the impact could be greater.

Mitigation may be warranted if an unanticipated discovery or if the known cultural resources located in the LCFS cannot be avoided. These measures would be determined by PEF in consultation with the Florida SHPO. Based on the previous analysis and because building of transmission lines does not require NRC authorization, the NRC staff concludes that the potential impacts on historic and cultural resources from NRC-authorized construction activities would be SMALL, and no mitigation beyond the PEF's commitments would be warranted.

4.7 Meteorological and Air Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality at the site. The primary impacts of building two new units on local meteorology and air quality would be from dust from land-clearing activities, open burning, emissions from equipment and machinery, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.7.1 Construction and Preconstruction Activities

Construction and preconstruction activities at proposed LNP Units 1 and 2 would result in temporary impacts on local air quality as a result of emissions associated with ground-clearing activities. Similar to any large-scale building project, dust particle emissions would be generated during ground-clearing, grading, and excavation activities. Fugitive dust particles would be generated from the movement of machinery and materials, as well as during windy periods over recently disturbed or cleared areas. The FDEP and EPA have created standards for fugitive dust emissions. PEF has committed to preparing a dust-control plan before the start of preconstruction and construction activities, and a number of dust-control measures are described in its ER (PEF 2009a). These measures include stabilizing ground surfaces with vegetation or gravel and wetting roadways.

A temporary concrete batch plant would be installed at the site. Emissions from the batch plant would consist of both particulate matter and exhaust from trucks moving concrete or raw materials. If a temporary permit is required for the operation of the batch plant, one would be obtained from the FDEP (PEF 2009a). Fill material used during construction and preconstruction activities could be obtained from a number of sources, including the Tarmac King Road Limestone Mine. This particular source of fill is located approximately 2 mi west of the LNP site and is therefore considered here for context. The mine would be a minor source of fugitive dust emissions, as described in Florida Air Quality Permit 0750089-001-AC.

Exhaust emissions from vehicles and equipment would also generate smaller amounts of particulate matter. In addition, these emissions would contain CO, NO_x, and VOCs. As discussed in Section 4.4.1.2 of the ER (PEF 2009a), Levy County is an attainment area for all criteria pollutants for which NAAQSs have been established (40 CFR 81.310). As a result, a conformity analysis of direct and indirect emissions is not required (58 FR 63214). If activities include the burning of debris, refuse, or residual construction materials, a permit would be secured from the State.

Preoperational activities would result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-year construction period and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building two nuclear power units at the LNP would be on the order of 70,000 MT, compared to a total United States annual CO_2 emission rate of 6,000,000,000 MT (EPA 2009). Appendix I provides the details of the review team's estimate for a reference 1000-MW(e) nuclear power plant. Based on its assessment of the relatively small construction equipment carbon footprint compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction and preconstruction activities would not be noticeable, and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including greenhouse gas emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. Considering the information provided by PEF and its commitment to implement a variety of control measures and to "follow applicable air pollution-control regulations," the review team concludes that the impacts from construction and preconstruction activities on air quality at the LNP site would not be noticeable.

4.7.2 Transportation

Construction and preconstruction activities at the LNP site would increase traffic on local roads. Access to the site is proposed through two driveways on US-19 and a heavy-haul road intersection crossing CR-40. The northern US-19 driveway is proposed as a "construction only" driveway, while the southern US-19 driveway is proposed as the main site access upon completion of construction (Kimley-Horn 2009). During the peak construction period, the overall workforce would be about 3300 (Kimley-Horn 2009). In addition, up to 500 operations employees would be trained during the peak of construction. PEF (2009a) estimated that there would be 2262 vehicles entering and exiting the LNP site daily, and US-19 would operate at an acceptable level of service during the construction phase of the project.

In addition to traffic on US-19 and CR-40, a proposed blowdown pipeline route located on the north side of the CFBC would cross the CR-40 and US-19 bridge. After crossing the CFBC, the route would also cross under an unpaved road and an unpaved bicycle/pedestrian path that parallel the southern side of the CFBC and are maintained by the Office of Greenways and Trails. PEF would coordinate with the FDOT and county officials to lessen the impacts of traffic along on the proposed blowdown pipeline route (PEF 2009a).

While air emissions from transportation are unavoidable, PEF would use BMPs related to construction and preconstruction activities to minimize impacts on the local ambient air quality. PEF has not identified any measures specifically related to transportation emissions. However, the ER discusses the following controls and procedures that, in general, would reduce air emissions:

- Grading would be performed to promote good drainage.
- Ground surfaces would be stabilized as soon as practical to prevent wind erosion.
- Areas that would revert to maintained grounds would be reseeded as soon as practicable to reduce the potential for fugitive dust generation.
- During dry conditions, bare ground in the disturbed area and along nearby roads would be wetted to minimize the generation of fugitive dust from vehicle traffic.
- Roadways used to access the LNP site would be wetted to minimize fugitive dust from traffic or operation of heavy equipment.
- Open or lightly traveled areas would either be paved, covered in hard-packed aggregate, or vegetated to minimize fugitive dust emissions from traffic and wind erosion.
- Heavily traveled unpaved roads and laydown areas would be stabilized with suitable materials, such as stone dust, to prevent wind erosion or fugitive dust generation by heavy equipment.
- Applicable regulations for air-pollution control with regard to open burning and the operation of fueled vehicles would be followed.
- Where required, permits and operating certificates would be obtained.
- Fuel-burning equipment would be maintained in proper mechanical order to minimize emissions.
- All reasonable precautions would be implemented to prevent accidental brush or forest fires.
- A fugitive dust-control plan would be developed and reviewed periodically to assess and improve the effectiveness of fugitive dust-control measures and practices.

With the implementation of these mitigation measures, the review team concludes that the impacts on air quality from transportation during construction and preconstruction would be negligible.

Construction workforce transportation would also result in greenhouse gas emissions, principally CO_2. Assuming a 7-year construction period and a typical workforce, the review team estimates that the total construction workforce CO_2 emission footprint for building two nuclear power units at the LNP site would be of the order of 300,000 MT. This is compared to a total United States annual CO_2 emission rate of 6,000,000,000 MT (EPA 2009). Appendix I provides the details of the review team estimate for a reference 1000-MW(e) nuclear power plant. Based on its assessment of the relatively small construction workforce carbon footprint compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction workforce transportation would not be noticeable, and additional mitigation would not be warranted.

4.7.3 Summary of Meteorological and Air-Quality Impacts

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from LNP site-development activities during construction and preconstruction and determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of LNP site development on air quality from emissions of criteria pollutants and CO_2 emissions during construction and preconstruction would be SMALL and that no further mitigation would be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air quality impacts of NRC-authorized construction activities would also be SMALL. The NRC staff also concludes that no further mitigation, beyond PEF's commitments, would be warranted.

4.8 Nonradiological Health Impacts

Nonradiological health impacts on the public and workers from construction- and preconstruction-related activities include exposure to dust and vehicle exhaust, occupational injuries, and noise, as well as the transport of materials and personnel to and from the site. The LNP site is located in a predominantly rural, lightly populated area of Levy County, Florida. Goethe State Forest is located directly northeast of the site. The towns closest to the site are Inglis (estimated population for 2006 was 1731, 4.1 mi from the site) and Yankeetown (estimated population for 2006 was 4564, 8.0 mi from the site) (PEF 2009a). The approximate population residing within 10 mi of the site was 17,475, based on data from the USCB for 2000 (PEF 2009a). Primary land uses in the vicinity are evergreen, deciduous, and mixed forest; agriculture; forested wetland; and residential (PEF 2009a). The CREC is located approximately 9.6 mi south of the LNP site. People who are vulnerable to nonradiological health impacts from construction- and preconstruction-related activities include: construction workers and personnel working at LNP, people working or living in the vicinity of or adjacent to the site, and transient populations in the vicinity (i.e., temporary employees, recreational visitors, and tourists).

4.8.1 Public and Occupational Health

This section discusses the impacts of building the proposed LNP Units 1 and 2 on public nonradiological health and the impacts from site preparation and development on worker nonradiological health. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the LNP site.

4.8.1.1 Public Health

PEF stated that fugitive dust may be generated during land clearing and development activities, as well as by exhaust from construction equipment (PEF 2009a). Exhaust emissions from construction equipment are predicted to include particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), NO_x, CO, and VOCs. PEF states that the emissions are likely to be similar to those from other large building projects, and air quality impacts beyond the site boundary are likely to be minimal owing to the large extent of the site (3105 ac) and long distances from the locations where the most activities would occur to the site boundaries (PEF 2009a). The nearest accessible area is approximately 1 mi from the disturbance site for proposed LNP Units 1 and 2, and the nearest residences are 1.6 mi to the northwest and 1.7 mi to the west-southwest (PEF 2009a).

Operational measures that would be taken to reduce emissions were discussed in Section 4.7.2. Given the mitigation measures for fugitive dust suppression and vehicle exhaust emission that would be used and the general public's distance away from the LNP site, the review team expects that the impacts on nonradiological public health from construction and preconstruction air emissions would be negligible.

4.8.1.2 Construction Worker Health

According to the U.S. Bureau of Labor Statistics (BLS), injury rates drop significantly for large construction projects, such as nuclear power facilities. The reports take into account occupational injuries and illnesses as total recordable cases, which includes the cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The review team estimated the annual number of occupational injuries based on U.S. total recordable case rates for utility construction for the year 2008 (4.1 per 100 full-time workers), and based on the Florida recordable case rate for utilities employment in 2004 (5.5 per 100 full-time workers), which were the most recent years that data were available (BLS 2010a, b). The time profile of construction worker employment specified by PEF (PEF 2009d) indicates that 750, 1000, 1900, 3100, 3300, 2900, 1250, and 100 workers would be employed in each respective year of construction (beginning in 2012). Based on this profile, the estimated total occupational injuries and illnesses associated with construction would be between 588 and 789 for the entire construction process, depending on whether the 2008 national injury rates or 2004 Florida rates are used, respectively. When interpreting these results, it is especially important to recall that they are gross (total) injury estimates. If the workers are not employed building the LNP, they would be doing other work or would be unemployed. As noted above, the injury rate for employment in utility construction is low compared to most other construction activities. Thus, the estimates developed above are conservative worst-case estimates of the net impact of LNP construction activities on workplace injuries.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with construction. PEF has committed to fully adhering to NRC, OSHA, and State safety standards, practices, and procedures during any activities related to site preparation/excavation or building the proposed LNP (PEF 2009i; FDEP 2010a).

Other nonradiological impacts on workers who are clearing land or building the facility discussed in this section include noise, fugitive dust, and gaseous emissions resulting from site preparation and site development activities. Mitigation measures discussed in this section for the public, such as operational controls and practices, would also help limit exposure to workers. Onsite impacts on workers also would be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care and regular health and safety monitoring of personnel also could be undertaken.

4.8.1.3 Summary of Public and Construction Worker Health Impacts

Based on mitigation measures identified by PEF in its ER, adherence to permits and authorizations required by State and local agencies, and the review team's independent evaluation, the review team concludes that the nonradiological health impacts on the public and workers for construction and preconstruction activities would be minimal, and no further mitigation would be warranted.

4.8.2 Noise Impacts

Development of a nuclear power plant project is similar to development of other large industrial projects, and it involves many noise-generating activities. Federal regulations governing noise from activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. As with other occupational injuries, noise-associated adverse impacts on workers would be limited by adherence to the applicable workplace standards.

The Levy County Noise Ordinance (Levy County Code 50-349) limits sound levels experienced by offsite receptors due to construction and other industrial activities. For residential, rural, agricultural, and commercial districts, the maximum allowable noise level at the property line is 65 dBA for the hours of 7:00 a.m. to 10:00 p.m. For industrial districts, the maximum allowable noise level is 75 dBA at all times. Allowable noise limits are lower during the hours of 10:00 p.m. to 7:00 a.m. in residential areas (55 dBA) and rural districts (60 dBA).

Construction Impacts at the Proposed Site

To estimate the overall noise impacts of construction and assess compliance with the Levy County Noise Ordinance, a noise assessment of the LNP site was performed in support of the LNP's Site Certification Application to the State of Florida. The closest noise-sensitive receptors were identified as being the residences located approximately 1.6 mi to the northwest and 1.7 mi to the west-southwest of the center of the project site. Individuals participating in recreational activities on the Inglis Island Trail in Goethe State Forest might also be affected by noise resulting from construction and preconstruction activities (PEF 2009a).

The noise assessment, which was based on an ambient background noise measurement program and a comprehensive noise modeling analysis using the Computer-Aided Noise Abatement noise model, indicated that noise from equipment used for clearing, excavation, and building activities may be perceptible at the nearest offsite locations during intense building activities. However, most offsite noise levels (at the locations of the nearest residences and sensitive receptors) are predicted to be below the daytime noise limitation of 65 dBA established by the Levy County Noise Ordinance for residential, rural, and commercial districts during the hours of 7 a.m. to 10 p.m. (PEF 2009a).

The noise assessment indicated that noises from construction and preconstruction activities might exceed this level for short periods of time during the most intense noise-generating activities (such as pile driving). BMPs, including restriction of deliveries and noise-generating activities to daylight hours and inspection and maintenance of equipment, would be established and reviewed periodically (PEF 2009a).

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. As discussed, it is unlikely that noise levels would be consistently greater than 60 dBA at the nearest residence. More recently, the impacts of noise were considered in NUREG-0586, Supplement 1 (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels, but was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Based on the temporary nature of construction and preconstruction activities and the location and characteristics of the LNP site including its large size and exclusion area, as well as the distance to the nearest residences, the review team concludes that the noise impacts from building proposed Units 1 and 2 would be minimal, and further mitigation would not be warranted.

4.8.3 Transporting Construction Materials and Personnel to the Proposed Site

This EIS assesses the impact of transporting workers and construction materials to and from the LNP site from the perspective of three areas of impact: the socioeconomic impacts, the air quality impacts of dust and particulate matter emitted by vehicle traffic, and potential health impacts due to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 4.4.1.3, and air quality impacts are addressed in Section 4.7.2. The impacts evaluated in this section for two new nuclear generating units at the LNP site are appropriate for characterizing the alternative sites discussed in Section 9.3. Alternative sites evaluated in this EIS include Crystal River in Citrus County, Dixie in Dixie County, Highlands in Highlands and Glades counties, and Putnam in Putnam County. There is no meaningful differentiation among the proposed and alternative sites regarding the nonradiological environmental impacts from transporting construction materials and personnel to the LNP site and alternative sites, and these issues are not discussed further in Chapter 9.

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the LNP site and alternative sites. The assumptions made to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are discussed below.

Construction material requirements are based on information taken from the LNP ER (PEF 2009a, d). PEF estimated that constructing a new Westinghouse Electric Company, LLC (Westinghouse) AP1000 pressurized water reactor unit requires up to 61,750 yd^3 of concrete, 3107 T of structural steel and rebar, 9,000,000 linear ft of cable, 275,000 linear ft of piping, and 600,000 yd^3 of fill.

- The review team assumed that shipment capacities are approximately 13 yd^3 of concrete, 11 T of structural steel, and 3280 linear ft of piping and cable per shipment. The review team assumed these materials would be transported to the site in a levelized manner (i.e., evenly distributed) over an 8-year period based on the schedule given in the ER (PEF 2009a).

- The number of construction workers was estimated to peak at 3300 (Kimley-Horn 2009). This value represents the peak workforce for building two units simultaneously. In addition, 500 operational workers were estimated to be present at this same time (Kimley-Horn 2009). A total of 2262 vehicles was estimated to enter and leave the LNP site daily (Kimley-Horn 2009). Each person was assumed by the review team to travel to and from the site 250 days per year.

- The review team assumed the average shipping distance for construction materials to be 50 mi one way.

- The review team assumed the average commuting distance for construction workers to be 20 mi one way, based on U.S. Department of Transportation (DOT) data that estimate the typical commute is 16 mi (DOT 2003).
- Accident, injury, and fatality rates for transporting building materials were taken from Table 4 in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Rates for the State of Florida were used for construction material shipments, typically conducted in heavy-combination trucks. The data provided by Saricks and Tompkins (1999) are representative of heavy-truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). To develop representative commuter-traffic impacts, Florida-specific accident, injury, and fatality rates for the years 2003 to 2007 (FLHSMV 2007) from the Florida Department of Highway Safety and Motor Vehicles were used.
- The DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined the rates were under-reported. Therefore, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI) (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 percent and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting. These adjustments were applied to the construction materials, which are transported by heavy-truck shipments similar to those evaluated by Saricks and Tompkins (1999) but not to commuter traffic accidents.

The estimated nonradiological impacts of transporting construction materials to the proposed LNP site and transporting construction workers to and from the site are listed in Table 4-15. The estimates for materials would be doubled for building two units at the proposed LNP site. Based on Table 4-15, the nonradiological impacts are dominated by transport of construction workers to and from the LNP site. The total annual construction fatalities related to building the facility represent about a 3-percent increase above the average 17 traffic fatalities per year that occurred in Levy County from 2003 to 2007 (FLHSMV 2007). Increases for the alternative sites were about 2 percent for the Crystal River site in Citrus County, 6 percent for the Dixie site in Dixie County, 2 to 8 percent for the Highland site in Highland and Glades Counties, and 2 percent for the Putnam site in Putnam County. These increases are negligible relative to the current traffic fatality risks in the area surrounding the LNP site and alternative sites.

Table 4-15. Annual Nonradiological Impacts of Transporting Workers and Materials to and from the Proposed LNP Site for a Single AP1000 Reactor

	Accidents per Year Per Unit	Injuries per Year Per Unit	Fatalities per Year Per Unit
Workers	2.9×10^{1}	2.5×10^{1}	3.8×10^{-1}
Materials			
Concrete	1.4×10^{-2}	1.2×10^{-3}	1.1×10^{-2}
Rebar; Structural Steel	8.2×10^{-4}	7.2×10^{-5}	6.3×10^{-4}
Cable	8.0×10^{-3}	7.0×10^{-4}	6.1×10^{-3}
Piping	2.4×10^{-4}	2.2×10^{-5}	1.9×10^{-4}
Fill	1.3×10^{-1}	1.2×10^{-2}	1.0×10^{-1}
Total – Materials	1.6×10^{-1}	1.4×10^{-2}	1.2×10^{-1}
Total – Construction	2.9×10^{1}	2.5×10^{1}	5.0×10^{-1}

Based on information provided by PEF, the review team's independent evaluation, and considering the number of shipments of construction materials and workers that would be transported to the LNP and alternative sites, the review team concludes that the nonradiological health impacts of construction and preconstruction activities from transporting building materials and personnel to the LNP site and alternative sites would be negligible, and no further mitigation would be warranted.

4.8.4 Summary of Nonradiological Health Impacts

As part of its evaluation on nonradiological health impacts, the review team considered the mitigation measures identified by PEF in its ER, responses to information requests, and relevant permits and authorizations required by State and local agencies for building LNP Units 1 and 2. The review team evaluated nonradiological impacts on public health and construction workers from fugitive dust, occupational injuries, noise, and transport of materials and personnel to and from the LNP site. No significant impacts related to the nonradiological health of the public or workers were identified during the course of this review. Based on information provided by PEF and the review team's independent evaluation, the review team concludes that the nonradiological health impacts of construction and preconstruction activities associated with the proposed LNP Units 1 and 2 would be SMALL, and no further mitigation would be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the nonradiological health impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that no mitigation, beyond the PEF's commitments, would be warranted.

4.9 Radiation Exposure to Construction Workers

The sources of radiation exposure for construction workers at LNP would include direct radiation exposure, exposure from discharges of liquid radioactive waste, and exposure from gaseous radioactive effluents after LNP Unit 1 becomes operational. The impacts of this exposure are described in the following sections and summarized in Section 4.9.5. For purposes of this discussion, construction workers are assumed to be members of the public, so the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR Part 20 Subpart D.

PEF plans to receive nuclear fuel and start up Unit 1 prior to completion of Unit 2 (PEF 2009a). Once proposed LNP Unit 1 is operational, gaseous and liquid radioactive materials would be released and there would be radioactive waste onsite. Construction workers on proposed LNP Unit 2 would be exposed to radiation from LNP Unit 1. CREC Unit 3 is located 9.6 mi from the LNP site and therefore would not be a source of radiation exposure for construction workers at the LNP site.

The following sections address the calculated exposure to the LNP Unit 2 construction worker associated with direct radiation, gaseous effluents, and liquid effluents from LNP Unit 1.

4.9.1 Direct Radiation Exposures

In the ER (Section 4.5.2), PEF identified proposed LNP Unit 1 as a potential source of direct radiation exposure to proposed LNP Unit 2 construction workers (PEF 2009a). The NRC staff did not identify any additional sources of direct radiation during the December 2008 site audit or during document reviews.

According to Section 12.4.2.1 of the Westinghouse AP 1000 Design Control Document (DCD) (Westinghouse 2008), refueling water would be stored inside the containment instead of in an outside storage tank, as at other facilities, so it would not contribute significantly to external radiation levels at the proposed LNP Unit 1 fence line. PEF stated that direct radiation exposure to construction workers beyond the proposed LNP Unit 1 fence line from the containment building and other facility buildings would be negligible. NRC staff reviewed the PEF approach and doses to construction workers and concluded they were appropriate.

4.9.2 Radiation Exposures from Gaseous Effluents

PEF calculated doses to construction workers at proposed LNP Unit 2 from LNP Unit 1 operation using expected annual airborne effluent releases. Using GASPAR II (Strenge et al. 1987), PEF estimated total body dose of 2.7 mrem/yr. This dose was adjusted for worker occupancy assumed to be 2080 hours annually (PEF 2009a). The NRC staff performed confirmatory dose calculations using the information contained in the PEF ER and 2 years of meteorological data.

4.9.3 Radiation Exposures from Liquid Effluents

Liquid effluents would be transported away from LNP Unit 1 in blowdown piping to a discharge structure located more than 9.6 mi away in the southwest direction. As such, potential exposure to liquid effluents would be a negligible contribution to proposed LNP Unit 2 construction worker dose.

4.9.4 Total Dose to Site Preparation Workers

PEF estimated a total body dose to a LNP Unit 2 construction worker from all pathways to be 2.7 mrem/yr, assuming a 2080 hr/yr occupancy and that the direct radiation and liquid effluent pathway contributions are negligible. This dose is less than the 100-mrem annual dose limit to an individual member of the public found in 10 CFR 20.1301.

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during the building of the proposed Units 1 and 2 is well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by PEF and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts on construction workers for proposed LNP Units 1 and 2 would be SMALL, and no further mitigation would be warranted. Radiation exposure from all NRC-licensed activities, including operation of LNP Units 1 and 2, is regulated by the NRC. Therefore, NRC staff concludes the radiological health impacts for NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted

4.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities for LNP Units 1 and 2. As discussed in Section 3.4.4, the types of nonradioactive waste that would be generated, handled, and disposed of during building activities include cleared vegetation, building material debris, municipal waste, spoils, stormwater runoff, sanitary waste, dust, and other air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

4.10.1 Impacts on Land

Vegetation removed from areas requiring clearing would be handled using a combination of chipping, spreading, and stockpiling for decomposition onsite or within the limits of the corridor; by burning onsite or within the limits of the corridor; and by offsite disposal in an approved disposal facility. A temporary storage area for the stockpiling of vegetative waste material would be provided for materials that would not be disposed of onsite. The selection of options for individual areas of the proposed project would depend on landowner requirements, agency permitting conditions, and relative costs. No vegetative waste would be disposed of in wetland areas.

The areas requiring clearing and grubbing would include the area of the power plant, adjacent facilities, and access roads; the 150-ft-wide corridor for the trench for the six 54-in.-diameter intake and discharge pipelines, an adjacent building road, and excavated trench spoils; and the corridor for the 50-ft-wide heavy-haul road and associated drainage swales. In these areas, vegetation would be cleared to ground level, and the vegetative layer and organic topsoils would be removed. Topsoil would be stockpiled along the corridors or in designated areas and reused to restore temporarily disturbed areas (PEF 2009i).

Within the transmission-line corridors, only vegetation taller than low-growth shrubs would be removed except as required for towers and access roads (PEF 2009i). This vegetative material would be ground up and spread in the corridor, unless specific landowner restrictions require them to be removed and disposed of offsite. PEF does not expect to perform any open burning within the transmission-line corridors. If any areas to be cleared have significant tree cover, the clearing contractor would be encouraged to consider harvesting the usable trees for wood or wood pulp. The quantities of vegetative waste have not yet been estimated in part because the exact alignments within the proposed corridors have not been determined. Therefore, the actual vegetative cover of the alignment is unknown.

Most of the plant equipment would be produced offsite and delivered in modular units, thereby reducing the generation of onsite waste. Building would generate small quantities of waste, such as scrap wood, wallboard, plastics, paper, and metal, which would be recycled or disposed in a local landfill appropriate for handling building debris. Municipal trash generated by the workforce during building activities may include food waste, glass, metals, cloth, plastics, and paper. Trash would be collected in local designated trash receptacles, transferred to onsite dumpsters, and disposed of in an offsite permitted landfill (PEF 2009i).

The slurry trench for the proposed diaphragm wall is expected to be excavated in panels using mechanical or hydraulic clamshell grabs or hydromills, as opposed to continuous trenching, thereby minimizing slurry requirements and allowing greater slurry reuse. Excess slurry from the building of the diaphragm wall and excess asphalt from building roads would be recycled or disposed of in accordance with all applicable Federal, State and local requirements. Waste concrete would be crushed and used onsite for road aggregate or removed from the site and disposed of by the building contractor (PEF 2009i).

Engineering projections of the soil cut-and-fill balance indicate that the proposed project would require approximately 1,000,000 yd^3 of additional clean fill to reach design grades. Therefore, no clean excavation spoils are expected to require disposition offsite. Little or no organic soil is expected to require disposition offsite (PEF 2009i).

Based on the proposed practices for minimizing the generation of solid waste and the plans to manage solid wastes in compliance with all applicable Federal, State and local requirements and standards, the review team expects that impacts on land from nonradioactive solid wastes generated during the building of LNP Units 1 and 2 would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts on Water

Building activities would generate liquid wastes from the sanitary wastewater-treatment system and from stormwater runoff.

During building activities, portable toilets would be supplied and serviced by a licensed sanitation contractor. The portable toilets would be pumped on a regular basis and the waste would be trucked to a municipal wastewater-treatment facility. The provision of portable restrooms for building sites is governed by Chapter 64E-6.0101 of the Florida Administrative Code (Fla. Admin. Code 64E-6.0101). There would be no onsite discharges from the portable toilets.

The proposed sanitary waste-treatment plant would consist of two package sewage-treatment plant units that would support the sanitary-wastewater requirements of the building workforce. The two plants would be designed to support up to 3500 people per day during building activities. The sewage-treatment plants would each have a capacity of 35,000 gpd using the contact stabilization process.[a] Each plant would include an individual 12,000-gal clarifier tank, while a common 17,000-gal surge tank and a common 30,000-gal sludge-holding tank would serve both plants (PEF 2009a).

In accordance with Florida law, any discharges during building activities would need to comply with all applicable provisions of NPDES Permit No. FL0633275-IW1S/NP upon final issueance (FDEP 2010a). Sanitary wastewater would be treated to the levels stipulated in the NPDES permit before being combined with the cooling-water system blowdown for discharge to the CREC discharge canal (PEF 2009a).

PEF would use the Generic Permit for Stormwater Discharge from Large and Small Construction Activities administered by the FDEP for stormwater discharges during building activities. The application process for coverage under the generic permit requires that PEF

(a) In the contact stabilization process, activated sludge is added to the wastewater influent, which then passes through a clarifier. Clarifier effluent undergoes additional aeration in a stabilization tank.

prepare a SWPPP and submit a Notice of Intent to the FDEP NPDES Stormwater Notices Center (PEF 2009a). Section 4.2.3.1 discusses the management of stormwater and the SWPPP.

Based on the proposed practices for managing liquid wastes in compliance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts on water from nonradioactive liquid wastes generated during building activities would be minimal, and no further mitigation would be warranted.

4.10.3 Impacts on Air

Building activities would cause impacts on air quality by the generation of dust, the burning of stripped vegetation, and by combustion of fuel in vehicles and equipment. Air quality impacts from building activities are discussed in detail in Section 4.7.1.

Building activities at the LNP site would generate dust from earthmoving activities and from the travel of vehicles and equipment on unpaved roads. Once cleared, exposed land areas may also generate fugitive dust as a result of wind erosion. Such activity would occur far from the site boundaries to minimize offsite impacts.

If vegetation from land clearing were burned, additional particulate emissions would be generated. Burning would take place only if approved by the appropriate agency. No burning would occur if the FDEP or the Division of Forestry were to issue a temporary ban on burning due to air pollution or fire-safety conditions.

The large mass of concrete required for the building foundations and other structures would require the installation and operation of a temporary concrete batch plant. Activities at the plant associated with the movement of aggregates and cement would generate dust. Mitigation measures, such as the use of dust-suppression water sprays on aggregate stockpiles, would minimize this dust generation. Because the concrete batch plant would be located far from the site boundaries, no discernible impacts are expected at offsite locations.

The operation of diesel-powered heavy equipment would generate additional particulate emissions, primarily PM_{10} and smaller, as well as the gaseous combustion byproducts SO_2, NO_x, and CO. These emissions are expected to be consistent with emissions from other building projects of this size, and there should be no significant impacts on air quality at offsite locations during the building period. Traffic caused by workers commuting to and from the LNP site would also produce vehicle emissions.

Along the transmission-line corridors, low ground cover would be left intact, minimizing areas of open soil and subsequent dust generation. PEF does not expect to perform any open burning within the transmission-line corridors.

In general, emissions from building activities (including greenhouse gas emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. During building, PEF would implement emission controls, mitigation measures, and air quality monitoring. The review team expects that impacts on air from nonradioactive airborne wastes generated during building activities would be minimal, and no further mitigation would be warranted.

4.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, and gaseous wastes generated when building LNP Units 1 and 2 would be handled according to county, State, and Federal regulations. Solid waste would be recycled; disposed of in existing, permitted landfills; or, in the case of vegetative waste only, chipped and spread onsite or burned in accordance with applicable regulations.

Sanitary wastes would be removed to an existing licensed sewage-treatment facility or discharged locally after being treated to the levels stipulated in the NPDES permit. A SWPPP would specify the mitigation measures to be put in place to manage stormwater runoff.

To avoid any noticeable, offsite air quality impacts, BMPs to control dust and minimize vehicle emissions would be expected.

Based on information provided by PEF and the review team's independent evaluation, the review team concludes that nonradioactive waste impacts on land, water, and air would be SMALL and that additional mitigation would not be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities also would be SMALL and that no further mitigation would be warranted.

4.11 Measures and Controls to Limit Adverse Impacts During Construction Activities

In its evaluation of environmental impacts during building activities for the proposed LNP Units 1 and 2, the review team relied on PEF's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts,
- compliance with applicable requirements of permits or licenses required for building the new units (e.g., USACE Section 404 permit and the NPDES permit),
- compliance with existing CREC processes and/or procedures applicable to proposed LNP Units 1 and 2 construction environmental compliance activities for the LNP site,

- incorporation of environmental requirements into construction contracts, and
- identification of environmental resources and potential impacts during the development of the ER and the COL process.

Table 4-16 on the following pages, which is the review team's adaptation from PEF's Table 4.6-1 (PEF 2009a), summarizes the measures and controls proposed by PEF to limit adverse impacts during building of proposed Units 1 and 2 at the LNP site.

Table 4-16. Summary of Measures and Controls Proposed by PEF to Limit Adverse Impacts During Construction of Proposed Units 1 and 2

Impact Category	Planned Mitigation and Controls
	Land-Use Impacts
The Site and Vicinity	On June 2, 2008, PEF submitted a Site Certification Application to the Florida Department of Environmental Protection (FDEP) (PEF 2008c) seeking State approval for building and operating LNP Units 1 and 2. On August 11, 2009, the Florida Siting Board unanimously approved the project. Entrix submitted a Wetland Mitigation Plan to FDEP on behalf of PEF (Entrix 2010). The plan is intended to demonstrate the availability of ample mitigation opportunities to achieve wetland compensation, which is required by both the Clean Water Act and Florida law. Acreage temporarily disturbed by construction would revert to open grassy areas after construction is finished, which is still a permanent conversion from pine plantations, forested wetlands, and mixed forests. To minimize impacts on surrounding land, the heavy-haul road would be collocated with the transmission-line corridor and the makeup-water and blowdown pipeline corridor. The location of the proposed heavy-haul road was selected by PEF because it is the shortest direct route to the LNP site from the cooling-water intake structure (CWIS), and it is slightly higher in elevation and contains fewer wetland areas than other potential locations that were considered (PEF 2008c). PEF has indicated that it would lessen the impact of construction and preconstruction activities by using mitigation measures such as erosion control, controlled access roads, and restricted construction zones. Stormwater runoff from LNP corridors would be controlled by a stormwater-drainage system. Stormwater collected in the ponds would be drained through emergency spillways, or it could be pumped to the cooling-tower blowdown basin if necessary.

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
Transmission Corridors and Offsite Areas	Transmission-line siting in Florida is regulated under the Florida Power Plant Siting Act (29 Fla. Stat. 403), and Fla. Admin. Code 62-17. Because transmission-line corridors would pass through a number of undisturbed lands, including wetlands, PEF has identified several measures that it would take to mitigate the impacts of construction. Upland areas would be cleared and then covered with a chipping material. Corridors that pass through wetlands would be cleared, although vegetation and trees would be cut back to avoid clearing where possible. Trees that are cut down would have their stumps and root systems left intact where possible. Land in the corridors after construction has been completed would be maintained in a herbaceous state. Vegetation 25 ft wide forming deep foliage screens with mature heights not exceeding 12 ft would be left intact where the corridor crosses navigable waterways, if practicable.
	Water-Related Impacts
Hydrologic Alterations	New drainage ditches and other features such as sediment filters and detention ponds would be used to accommodate surface-water runoff from altered drainage areas and the newly constructed impervious areas. Some wetlands would be filled. Building will occur in the 100-year floodplain. Placement of the blowdown pipeline would cross the Cross Florida Barge Canal (CFBC). Building of the barge slip would occur within the CFBC. Appropriate erosion control measures would be taken on all drainage features and wetlands to prevent turbid water, soil deposition, vegetation removal, etc. from occurring within those areas or downstream areas through the approved stormwater pollution prevention plan (SWPPP). A wetland compensation plan would be used. If noticeable loss in floodplain capacity results from building activities, a floodplain compensation plan would be used. Best management practices (BMPs) would be used to isolate building areas within the CFBC to prevent sediment discharge to the waters.
Water-Use Impacts	PEF would develop an environmental monitoring plan to ensure that the impacts on groundwater levels and quality and any related impacts on wetlands are adequately monitored. If adverse impacts are observed, PEF would be required to implement a mitigation strategy. PEF is required to prepare an alternative water-supply plan. This plan identifies other potential sources of freshwater that could be used to meet LNP requirements.

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
Water-Quality Impacts	Develop and implement a construction SWPPP and spill response plan.
	Adhere to applicable regulations and permitting requirements found in the National Pollutant Discharge Elimination System (NPDES) permit. Implement BMPs to prevent the movement of pollutants (including sediments) into wetlands and waterbodies via stormwater runoff and discharges from building activity areas within the CFBC. BMPs would include the use of erosion control measures such as silt fences and detention ponds to prevent sedimentation and turbid water discharge.
	Use of vegetated land buffers between waterbodies and the building activity site would minimize sedimentation impacts.
	PEF would comply with Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental effects (for example, solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, and hazardous waste management.
	Ecological Impacts
Terrestrial Ecosystems	Vegetation removal would be limited to only those areas needed for development-related activities. Temporarily disturbed sites would be restored in a timely manner.
	Most (75 percent) of the LNP site would remain undeveloped, providing a vegetated buffer around the centrally located LNP facilities. PEF's proposed wetland mitigation plan calls for ceasing commercial forest management over approximately 1549 ac of undeveloped areas remaining on the LNP site and part of a property owned by PEF directly south of the LNP site. Pine plantations and other disturbed habitats would be rehabilitated through a series of vegetation management and restorative processes to reestablish plant communities more functionally similar to native upland and wetland habitats. Restoration of these lands would help to mitigate the effects of fragmentation by creating a more contiguous native landscape on lands highly altered by forest management. As restored habitats again become available for use by wildlife, the higher-quality habitat provided by the restored communities would allow for an increase in wildlife diversity and species population levels, helping compensate for wildlife losses during construction and preconstruction.
	Fencing that could restrict movement by medium- and large-sized wildlife would be limited to areas close to LNP facilities to provide for security or industrial safety. Fencing would not be built around the LNP property line, thereby allowing unimpeded movement by wildlife between undeveloped areas onsite and adjacent offsite habitats.

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
	Wildlife displacement in adjacent habitats due to noise should be temporary in nature and primarily limited to daylight hours. Wildlife may return to undisturbed habitats upon completion of development. Over 90 percent of the new transmission lines would be collocated with existing PEF transmission lines. This practice would reduce the potential for bird collisions with structures and lines by limiting the number of rights-of-way that birds would need to cross. As a condition of certification, PEF would be required to develop an Avian Protection Plan for the transmission lines that would include measures to reduce potential collision impacts by birds. To comply with U.S. Army Corps of Engineers (USACE) and FDEP regulatory requirements, PEF would minimize impacts on wetlands and waterbodies during LNP site development, while siting transmission-lines. Because the final transmission-line rights-of-way would be narrow (100 to 220 ft wide) and collocated with existing transmission lines over about 90 percent of their range, the actual extent of upland and wetland clearing for the transmission lines would be greatly minimized. Measures would be taken prior to the dewatering and excavation of each proposed nuclear island to prevent significant drawdown to the surficial aquifer system that supports adjacent wetlands. An impervious reinforced diaphragm wall would be installed around the perimeter of each excavation, and the underlying bedrock would be sealed by drilling and pressure grouting to isolate and seal the dewatering areas, and minimize inflow into the excavations. Inflow and stormwater from within the excavations would be intermittently pumped and discharged to an infiltration basin. Monitoring of adjacent surface-water and groundwater levels would be conducted to ensure that dewatering impacts are minimized. If any detrimental impact on water levels supporting adjacent wetlands is detected, additional mitigative measures such as drilling and grouting, sheeting, or re-design of the recharge basins would be implemented. Unavoidable wetland impacts would be mitigated in compliance with Federal and State permitting processes. PEF has prepared a mitigation plan that would compensate for the loss or impairment of functions to all wetlands affected by development on the LNP site and the associated offsite facilities. PEF has committed to providing at least as many Florida Uniform Mitigation Assessment Methodology (UMAM) functional lift units as the actual LNP project losses. A condition of certification by the FDEP would require protocol surveys for all listed species (except plants) that may occur on the LNP site and associated offsite facilities prior to land “clearing and construction”. This condition of State certification also requires the applicant to consult with the FFWCC if listed species are identified during predevelopment surveys or if listed species are encountered during

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
	development to determine the need for appropriate mitigation. If listed species are detected and impacts cannot be avoided, appropriate mitigation could be required on a case-by-case basis. Under wetland mitigation planning, several hundred acres of low-value pine plantations and degraded wetlands would be rehabilitated and restored to native upland and wetland plant communities. The higher-quality habitat provided by these restored communities would likely be beneficial to many listed species.
Aquatic Ecosystems	Erosion and runoff control mitigation practices would be used to prevent siltation of preserved ponds onsite. Stormwater-management basins and cessation of forest plantation activities on the site would create improved freshwater aquatic habitat. Construction for both the barge-unloading facility and the intake structure would occur in upland areas behind an earth bank that separates construction activities from the CFBC until excavation is complete. Steel sheet piling would be installed at the barge slip and in a cofferdam for intake structure construction. Piles would be installed from land using a pile hammer. Turbidity barriers and erosion control measures would be installed in the canal during activities associated with sheet-pile installation to control impacts on water quality. Residual water from dredging activities would be tested for compliance with NPDES and Florida standards for surface-water quality before being returned to the CFBC. Construction of intake and discharge piping over the Inglis Lock bypass channel along an existing bridge would follow BMPs associated with stream-crossing regulations associated with minimization of sedimentation and bank erosion. PEF would site the new 500- to 230- and 65-kV transmission lines in accordance with PPSA and Fla. Admin. Code 62-17. PEF procedures for implementation include consultation with the FWS and an evaluation of impacts on special habitats and threatened and endangered species. All work would be conducted in accordance with Federal and State permitting requirements for maintaining water quality and protecting natural resources, such as maintenance of a 15 ft or greater buffer of natural vegetation for construction near waterbodies. PEF plans to leave a 25-ft buffer of existing vegetation with mature heights not exceeding 12 ft at locations where the corridor crosses a navigable waterway. Permits required include a USACE Section 10 – Rivers and Harbors Act Permit, National Marine

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
	Fisheries Service (NMFS) authorization under the Magnuson-Stevens Fishery Conservation and Management Act, FDEP Environmental Resources Permit, FDEP and Southwest Water Management District dewatering permit, and FDEP NPDES construction stormwater permit. PEF would comply with the Standard Manatee Conditions for In-Water Work (FDEP 2009b) for construction activities in the CFBC to prevent impacts on manatees in the vicinity of construction activities. These conditions include halting all construction-related activities if manatees are spotted within a 50-ft radius of the activity. A wildlife spotter is required during all construction-related activities. PEF plans to perform construction-related monitoring in the CFBC associated with construction of the CWIS and with the discharge piping placement. During construction activities, a biologist would be present to visually monitor for threatened and endangered species that may appear in the CFBC or CREC discharge areas.
	Socioeconomic Impacts
Social and Economic Impacts	To mitigate traffic impacts, PEF could develop and implement a site-development traffic-management plan that would include such measures as turn-lane installation where necessary, establishing a centralized parking area with shuttle service, encouraging carpools, and staggering shifts. Other methods to mitigate potential impacts include (1) avoiding routes that could adversely affect sensitive areas (e.g., housing, hospitals, schools, retirement communities, businesses) to the extent possible, and (2) restricting activities and delivery times to daylight hours. PEF would communication regularly with local government and planning officials to give them ample time to plan for the impact of the site-development-related population influx on housing. Efforts to mitigate potential housing shortages would be market-driven (provided by the normal reaction of housing construction to local demand and supply conditions) over time. Site-development employment would peak after build-up of several years. This would allow time for construction of new housing as well as for newly arriving in-migrating workers to locate into areas with greater housing availability. Temporary housing could be constructed as needed. PEF would maintain communication with local government officials so that police, emergency response, and fire-protection services could be coordinated, planned, and focused on the areas of highest priority, given that funding for expansion of capacity that would be provided through the increased tax revenues

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
	from the development project would occur only after the units begin operation and would be limited to Levy County. PEF would maintain communication with local school officials so that school capacity expansion could be coordinated, planned, and focused on the areas in which shortages might occur. Short-term solutions to school crowding could be implemented by adding modular classrooms and hiring additional teachers at existing schools. Within the framework of Florida's school equalization mechanisms, funding for additional resources would be provided through the increased tax revenues from the site-development project. In addition, PEF would coordinate with local and regional training institutions to increase the capacity of local residents to obtain employment in site-development-related activities.
Environmental Justice	Analysis of potential health effects, housing availability and public services and transportation in Levy, Citrus, and Marion Counties determined that the probability of minority and low-income populations absorbing a disproportionate impact through increased rental rates and housing costs or impacts on local public services is low. Because of this, specific control efforts – for example, rent controls – would not be necessary.
Historic and Cultural Properties	Take appropriate actions as required by site procedures following discovery of potential historic or archaeological resources and the Florida State site-certification process. PEF has agreed to complete comprehensive Phase I surveys prior to construction activities, once transmission-line corridors within the rights-of-way have been finalized (PEF 2009a). The transmission-line corridor from the proposed LNP to Central Florida South substation contains one site (8SM128) eligible for listing in the National Register of Historic Places (NRHP) and two sites having confirmed or potential human remains (8SM10 and 8SM84). Site 8SM128 is a site with both historic and prehistoric components. According to PEF (2009a), "These sites will be avoided to the maximum extent practicable during [right-of-way] selection and structure placement as described in ER Subsection 9.4.3. If avoidance of these three resources is not feasible, then appropriate minimization or mitigation measures will be developed in coordination with the SHPO."

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
Air Quality	Fugitive dust particles would be generated by the movement of machinery and materials as well as during windy periods over recently disturbed or cleared areas. The FDEP and the U.S. Environmental Protection Agency (EPA) have standards for fugitive dust emissions. PEF has committed to preparing a dust-control plan before the start of construction, and a number of dust-control measures are described in its ER (PEF 2009a). These measures include stabilizing ground surfaces with vegetation or gravel and wetting roadways and construction areas. A temporary concrete batch plant would be installed at the site. Emissions from the batch plant would consist of particulate matter and exhaust from trucks moving concrete or raw materials. If a temporary permit is required for the operation of the batch plant, one would be obtained from the FDEP (PEF 2009a). If construction activities include the burning of debris, refuse, or residual construction materials, a permit would be secured from the State. While air emissions from transportation are unavoidable, PEF would use BMPs related to the construction activities to minimize impacts on the local ambient air quality. PEF has not identified any measures specifically related to transportation emissions; however, the Environmental Report (ER) (PEF 2009a) discusses the following controls and procedures that, in general, would reduce construction-related air emissions: • Grading would be performed to promote good drainage. • Ground surfaces would be stabilized as soon as practical to prevent wind erosion. • Areas that would revert to maintained grounds would be reseeded as soon as practicable to reduce the potential for fugitive dust generation. • During dry conditions, bare ground in the construction area and along nearby construction roads would be wetted to minimize the generation of fugitive dust from vehicle traffic. • Roadways used to access the proposed LNP site would be wetted to minimize fugitive dust from traffic or heavy equipment operation. • Open or lightly traveled areas would either be paved, covered in hard-packed aggregate, or vegetated to minimize fugitive dust emissions from traffic and wind erosion. • Heavily traveled unpaved construction roads and laydown areas would be stabilized with suitable

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
	• materials such as stone dust to prevent wind erosion or fugitive dust generation by heavy equipment. • Applicable air pollution-control regulations with regard to open burning and the operation of fueled vehicles would be followed. • Where required, permits and operating certificates would be obtained. • Fuel-burning construction equipment would be maintained in proper mechanical order to minimize emissions. • All reasonable precautions would be implemented to prevent accidental brush or forest fires. • A fugitive dust-control plan would be developed and reviewed periodically to assess and improve the effectiveness of fugitive dust-control measures and practices. PEF stated that all applicable Federal, State, and local emission requirements would be adhered to as they relate to open burning or the operation of fuel-burning equipment in Section 4.4.1.2 of the ER (PEF 2009a). The appropriate Federal, State, and local permits and operating certificates would be obtained as required.
Nonradiological Health Impacts	PEF states that it would adhere to all NRC, OSHA, and State safety standards, practices, and procedures during building activities (PEF 2009i). PEF states that a safety and medical program would be provided for construction workers and that all construction contractors and site staff would be required to comply with and Federal, State, and County regulations governing site safety, fire, noise, security policies, safe work practices (FDEP 2010a). Operational controls would be used to reduce dust and vehicular air emissions (PEF 2008a). To mitigate potential transportation fatalities, PEF could develop and implement a site-development traffic-management plan (as mentioned in Social and Economic Impacts above). These actions would help minimize or prevent injury, illness, and death.
Radiation Exposure to Construction Workers	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20).

Table 4-16. (contd)

Impact Category	Planned Mitigation and Controls
Nonradioactive Waste	Solid, liquid, and gaseous wastes generated when building LNP Units 1 and 2 would be handled according to county, State, and Federal regulations. Solid waste would be recycled, disposed of in existing, permitted landfills or, in the case of vegetative waste only, chipped and spread onsite, or burned in accordance with applicable regulations. Sanitary wastes would be removed to an existing licensed sewage-treatment facility or discharged locally after being treated to the levels stipulated in the NPDES permit. A SWPPP would specify the mitigation measures to be put in place to manage stormwater runoff. BMPs to control dust and to minimize vehicle emissions would be expected to avoid any noticeable, offsite, air quality impacts.

4.12 Summary of Construction and Preconstruction Impacts

The Impact levels determined by the review team in the previous sections are summarized in Table 4-17. The impact levels for NRC-authorized construction are denoted in the table as being SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined preconstruction and construction activities are similarly noted. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level columns.

Table 4-17. Summary of Construction and Preconstruction Impacts for Proposed Units 1 and 2

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land-Use Impacts			
Site	In Chapter 4.0 of the ER, PEF estimated that 95 to 100 percent of the land-use impacts would be the result of preconstruction activities such as clearing, grading, building roads, excavation, and erection of support buildings (PEF 2009a). These land-use impacts would noticeably alter the existing land uses on the site, but would not destabilize the resource.	SMALL	MODERATE
Transmission Lines and Offsite Areas	NRC's LWA rule specifically indicates that transmission lines and other offsite activities are not included in the definition of construction. Land-use impacts from placement of new transmission lines would noticeably alter the existing land uses, but would not be destabilizing.	No impact	MODERATE
Water-Related Impacts			
Water Use – Surface Water	Construction and preconstruction impacts on surface-water use would be negligible.	SMALL	SMALL

1

Table 4-17. (contd)

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Water Use – Groundwater	Construction and preconstruction impacts on groundwater use would be negligible.	SMALL	SMALL
Water Quality – Surface Water	Construction and preconstruction impacts on surface-water quality would be negligible.	SMALL	SMALL
Water Quality – Groundwater	Construction and preconstruction impacts on groundwater quality would be negligible.	SMALL	SMALL
Ecological Impacts			
Terrestrial Ecosystems	Permanent cover type (habitat) losses would total about 627 ac on the LNP site and roughly 2008 ac for the associated offsite facilities. Temporary habitat losses are estimated at up to 400 ac for the LNP site (including losses of up to 250 ac that may be incurred to compensate for LNP site encroachments into the 100-year floodplain) and 30 ac for the associated offsite facilities. These habitat losses include permanent impacts on approximately 683 ac of wetlands (319 ac on the LNP site and roughly 364 ac for the associated offsite facilities), and temporary impacts on another 90 ac of wetlands (84 ac on the LNP site and 6 ac for the associated offsite facilities). As many as 32 listed wildlife species (9 Federally listed and 32 State listed) and 76 listed plant species (13 Federally listed and 76 State listed) could be affected by the proposed LNP project,	SMALL	MODERATE

Table 4-17. (contd)

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
	particularly along the transmission line.		
Aquatic Ecosystems	Construction and preconstruction activities would have minimal impact on aquatic ecological resources and habitat.	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	Physical impacts of building activities on workers, onsite and offsite buildings, and the general public would be minimal. Traffic-control and -management measures would protect any local roads during site development. Impacts from transmission lines and corridors could be MODERATE	SMALL	SMALL to MODERATE (if transmission lines are considered)
Demography	The population relocating to the region for the site-development activities likely would be SMALL relative to the existing population base.	SMALL	SMALL
Economic Impacts to Community	Impact of site development would be beneficial to local economies. In Levy County beneficial impacts would likely be MODERATE, while impacts elsewhere would be SMALL. For taxes, SMALL and beneficial impacts would occur throughout the region.	SMALL (beneficial)	SMALL to MODERATE (beneficial)

Table 4-17. (contd)

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Infrastructure and Community Services	Some public services in Levy and Marion counties are at capacity; consequently any temporary influx of workers and their families resulting from site development at the Levy site could have MODERATE adverse impacts. Some increases will be necessary in the number of fire-protection, emergency, and law enforcement personnel. Impact on education would be MODERATE in Levy and Marion Counties and SMALL in the region. Impact on transportation would be MODERATE in Levy County and SMALL elsewhere.	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice Impacts	There would be no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations.	SMALL	SMALL
Historic and Cultural Resource Impacts	Based on PEF procedures and commitments to follow those procedures, if historical and cultural resources are discovered, the impacts would be SMALL. Also based on PEF commitments to conduct transmission line surveys, the impacts would be SMALL, but could be greater.	SMALL	SMALL
Meteorology and Air Quality Impacts	Emissions of criteria pollutants would be temporary and limited and carbon footprint of construction workforce would not be noticeable.	SMALL	SMALL

Table 4-17. (contd)

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Nonradiological Health Impacts	Emissions of dust and air pollutants would be limited by operational controls; noise impacts would comply with Federal, State and County standards. Worker health and safety would be ensured by compliance with NRC, OSHA, and State standards. Transportation impacts would be minimal.	SMALL	SMALL
Radiological Health Impacts	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20).	SMALL	SMALL
Nonradioactive Waste	Impacts on water, land, and air from the generation of nonradioactive waste would be minimal.	SMALL	SMALL

4.13 References

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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14 Fla. Stat. 212.008. 2009. "Sales, Rental, Use, Consumption, Distribution, and Storage Tax; Specified Exemptions." *Florida Statutes.*

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 320, "General Regulatory Policies."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 204. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 204, "Noise Emission Standards for Construction Equipment."

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5.0 Operational Impacts at the Proposed Site

This chapter examines environmental issues associated with operation of proposed Units 1 and 2 at the Levy Nuclear Plant (LNP) site for an initial 40-year period as described by the applicant, Progress Energy Florida, Inc. (PEF). As part of its application for combined construction permits and operating licenses (COLs), PEF submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (PEF 2009a). The NRC staff, its contractors' staff, and the U.S. Army Corps of Engineers (USACE) staff (hereafter referred to as the "review team") independently evaluated information presented in PEF's Environmental Report (ER) (PEF 2009a) and supplemental documents, PEF's responses to NRC Requests for Additional Information (RAIs), PEF's Site Certification Application submitted to the Florida Department of Environmental Protection (FDEP) (PEF 2008a), the FDEP review of the proposed project (FDEP 2009a), USACE permitting documentation (Entrix 2010), as well as other government and independent sources.

This chapter is divided into 14 sections. Sections 5.1 through 5.12 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological and radiological health effects, nonradioactive waste, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the Code of Federal Regulations (CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned by the review team to each impact category. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The review team's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various state and county governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.13. The references cited in this chapter are listed in Section 5.14.

5.1 Land-Use Impacts

This section contains information about land-use impacts associated with operation of proposed Units 1 and 2 at the LNP site. Section 5.1.1 discusses land-use impacts at the site, in the vicinity, in the region, and in offsite areas. Section 5.1.2 discusses land-use impacts with respect to offsite transmission-line corridors.

5.1.1 The Site, Vicinity, Region, and Offsite Areas

Operational impacts are discussed for the LNP site and offsite areas within the vicinity of the site (i.e., within a 6-mi radius), and within the 50-mi region. Onsite land-use impacts from operation of proposed Units 1 and 2 are expected to be minimal because minimal additional land would be affected other than those lands disturbed during building of the plant. As described in Section 5.3.1.1, some onsite plants could suffer leaf damage due to salt drift from the two mechanical draft cooling towers, but no adverse impacts on vegetation are predicted for offsite lands in the vicinity.

Approximately 1280 ac of land in the vicinity of the LNP site would be affected by project-related support activities (PEF 2009c). PEF anticipates that most of these lands would be returned to preconstruction use during operation, although the heavy-haul and site access roads, barge slip, and makeup-water pump house would remain in use. Stormwater controls described as best management practices (BMPs) in Section 4.2.1 of this environmental impact statement (EIS) would be maintained during operations to minimize erosion and sedimentation in the offsite areas. Therefore, the review team concludes that the impacts of operations on other offsite areas, apart from the transmission-line corridors, would be minor, and additional mitigation would not be warranted.

5.1.2 Transmission-Line Corridors

Most land-use impacts associated with transmission lines would occur during the building of the new units. Land-use impacts during operations would be associated with corridor maintenance activities for actions such as vegetation management, tower repairs, and habitat maintenance.

PEF would maintain transmission lines and corridors in accordance with its maintenance plan described in Section 3.4.2.7 and as required in the FDEP’s Conditions of Certification (FDEP 2010). Maintenance practices are designed to be both preventative and corrective. PEF would conduct annual inspections of transmission-line corridors using both ground and aerial methods. The exact nature of maintenance activities would depend upon the location, type of terrain, and surrounding environment. Maintenance activities would also be adjusted to manage site-specific vegetation and habitat, with special accommodations made for endangered or threatened species (PEF 2009a).

Where a transmission-line corridor passes through agricultural lands, PEF would maintain a corridor-use program that considers requests for multiple uses. This would include agricultural operations, controlled landscaping, or other activities that do not disrupt PEF’s use of the corridor for maintenance and operation of the transmission line. Transmission-line corridors adjacent to, or in the proximity of, existing corridors generally would allow multiple uses consistent with those currently allowed.

No ground-disturbing activities are planned to occur during the maintenance of transmission lines constructed to support the operation of proposed LNP Units 1 and 2. Because PEF provides easements to allow agricultural activities under its transmission lines, and because many of the transmission lines would be collocated with existing transmission lines, the review team concludes that the land-use impacts associated with power transmission in support of plant operation would be minor, and additional mitigation would not be warranted.

5.1.3 Summary of Land-Use Impacts

Because minimal additional land would be affected other than that disturbed during building of the plant, onsite and offsite land-use impacts from operation of proposed Units 1 and 2 are expected to be minimal. Transmission-line maintenance activities are expected to have only minor land-use impacts during operations. Based on information provided by PEF and the review team's own independent review, the review team concludes that land-use impacts of operations would be SMALL.

5.2 Water-Related Impacts

This section discusses water-related impacts on the surrounding environment from operation of proposed LNP Units 1 and 2. Details of the operational modes and cooling-water systems associated with operation of the proposed units can be found in Section 3.2.2.2 of this EIS.

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the site of the proposed LNP Units 1 and 2, these objectives include navigation, recreation, visual aesthetics, a fishery, and a variety of beneficial consumptive water uses. The responsibility for any work in, over, or under navigable waters of the United States is delegated to the USACE. The FDEP is responsible for protecting and restoring the quality of Florida water, air, and land resources, and the Florida Department of Community Affairs is responsible for determination of project consistency with Florida's Coastal Zone Management Plan.

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power generation facility. Accordingly, PEF must obtain the same water-related permits and certifications as any other large industrial facility. These include the following:

- Clean Water Act Section 401 Certification. This certification is issued by the FDEP as part of Florida's Power Plant Siting Act (PPSA) Certification (29 Fla. Stat. 403) and ensures that the project does not conflict with State water-quality standards. This certification must be obtained before the NRC could issue a COL to PEF.

- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge Permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in Florida to the FDEP. The NPDES permits are part of the PPSA certification. A stormwater pollution prevention plan (SWPPP) would be required.
- Water-Use Permit. Consumptive use of surface water or groundwater would require a permit from the FDEP or the water-management district.

5.2.1 Hydrological Alterations

Hydrologic alterations during the operation of proposed LNP Units 1 and 2 are expected to be limited to the following activities:

- alteration of the flow pattern in the CFBC because of diversion of makeup water for normal plant operations
- alteration of the discharge plume in the Gulf of Mexico at the mouth of the Crystal River Energy Complex (CREC) discharge canal due to addition of the LNP discharge
- alteration of wetlands and surface water bodies near the LNP site because of deposition of salt carried with drift from cooling towers

Makeup water needed for cooling the reactors for proposed LNP Units 1 and 2 under normal operational mode would be supplied from the Gulf of Mexico via the CFBC using a new CWIS. The blowdown from the Units 1 and 2 cooling towers and other treated wastes would be discharged through a new discharge pipeline routed from the LNP facility into the existing CREC discharge canal and, eventually, to the Gulf of Mexico. Groundwater from onsite water-supply wells completed in the Upper Floridan aquifer would be used to supply general plant operations, including making up water lost through service-water cooling tower drift and evaporation, potable water supply, raw water to the demineralizer, fire protection, and media filter backwash (PEF 2009a).

Because of cooling water withdrawal from the CFBC at the CWIS, the flow patterns in the canal would change. The CFBC is connected to the Gulf of Mexico and is subject to tidal exchanges of water. There is occasional discharge of freshwater over the Inglis Dam spillway during flood events. Groundwater springs also contribute some flow to the Old Withlacoochee River below the Inglis Dam and to the CFBC below the Inglis Lock. Water withdrawn by the CWIS would capture the spring flows into the CFBC and also induce a net flow from the Gulf of Mexico into the canal. These surface water exchanges are described below.

Because of drift from the cooling towers, salt deposition would occur near the LNP site (PEF 2009a). The deposited salt may be dissolved in runoff following precipitation events and is subsequently carried off to nearby wetlands and surface water bodies. Section 5.3.1.1 describes this analysis and the associated impacts in more detail.

As discussed in Section 2.3.1.2, because the original groundwater model developed as a requirement of the Florida Site Certification Application under-predicted hydraulic heads in the vicinity of the LNP site, the staff requested that PEF recalibrate the model using both site-specific and regional head data. This recalibrated model resulted in predictions of increased drawdown and demonstrated that uncertainty in hydraulic property values in the vicinity of the proposed LNP wellfield can significantly influence assessment of wetlands impacts. Results from these predictive simulations using the recalibrated model indicate that annual average LNP groundwater usage from the Upper Floridan aquifer will, after 60 years of operation, result in surficial aquifer drawdowns of as much as 2 ft in areas where wetlands are present. In addition, the lateral extent of the 0.5-ft drawdown contour extends up to 3 mi from the pumping well locations (Figure 5-1). The predicted maximum drawdown affecting wetlands (less than 2.5 ft) is less than 31 percent of the normal seasonal variability (as much as 8 ft) observed in groundwater levels in the vicinity of the LNP site (see discussion of potentiometric surfaces in Section 2.3.1.2).

The FDEP conditions of certification require PEF to develop an environmental monitoring plan, which includes a hydraulic testing program during drilling and installation of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater-usage requirements without significantly affecting water levels in the surficial aquifer. The conditions of certification require that during operation of the LNP wellfield, PEF must limit drawdowns in the surficial aquifer to levels that ensure no adverse impacts on wetlands.

5.2.2 Water-Use Impacts

A description of water-use impacts on surface water and groundwater is presented in the following sections. The water resource usage by proposed LNP Units 1 and 2 operations is limited to diverting water from the CFBC for makeup-water needs during normal operations and pumping groundwater for general plant operations, including service-water tower drift and evaporation, potable water supply, raw water to the demineralizer, fire protection, and media filter backwash.

5.2.2.1 Surface Water

Waters obtained from the Gulf of Mexico and spring flow into the CFBC would be used as the source of makeup water used during normal plant operations. As stated in Section 3.4.2.1, LNP Units 1 and 2 would withdraw a maximum of 84,780 gpm (190 cfs) from the CFBC and discharge 57,923 gpm (129 cfs) of blowdown from the cooling system to the CREC discharge canal. Because the Gulf is virtually an unlimited source of water supply compared to the LNP Units 1 and 2 makeup-water requirements, the review team determined that the use of water

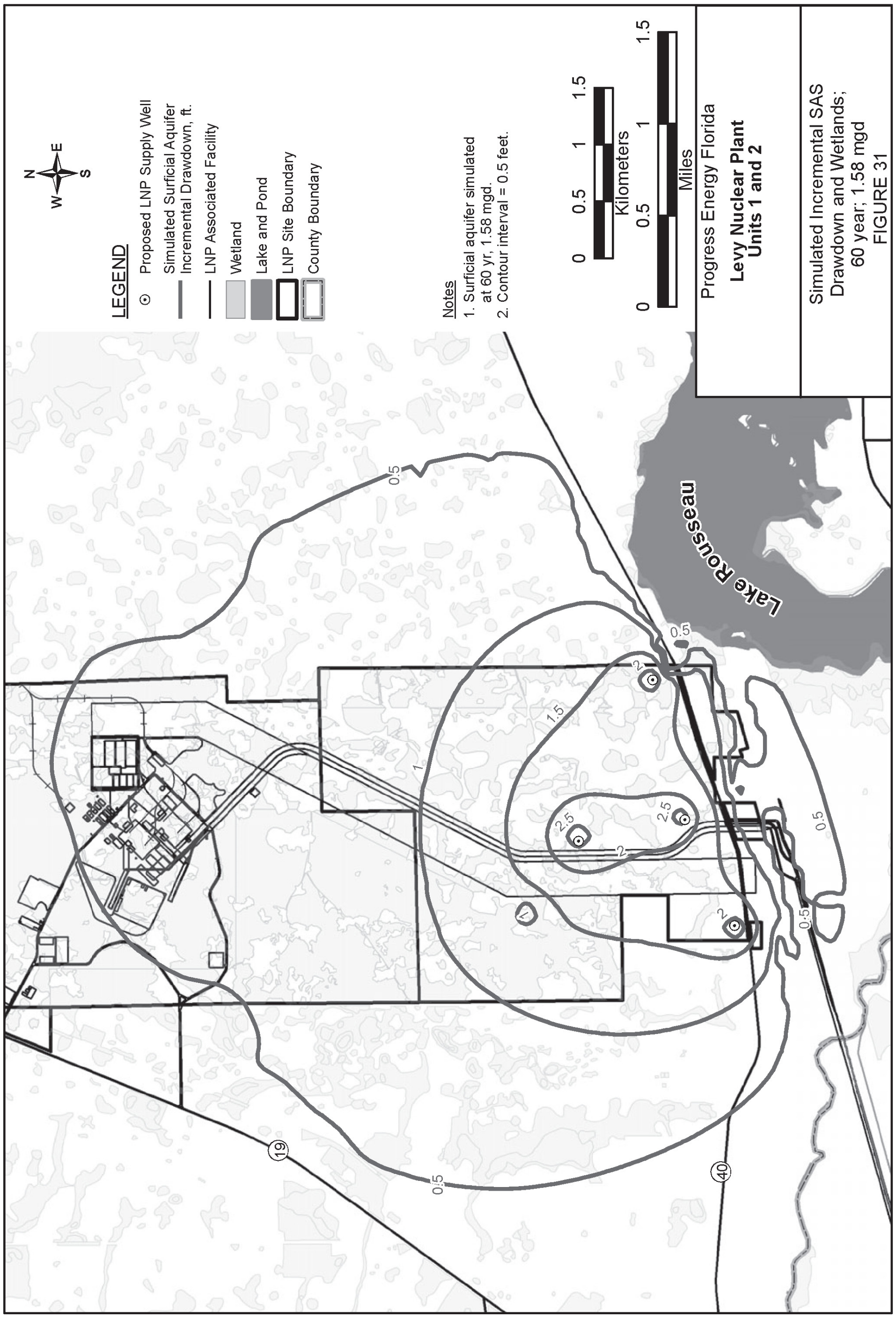

Figure 5-1. Simulated Incremental Surficial Aquifer System (SAS) Drawdown Associated with LNP Operations (PEF 2010a)

from the Gulf would have essentially no impact on it. Therefore, the impact on surface water resources due to LNP use during operations is expected to be SMALL and further mitigation measures would not be warranted.

5.2.2.2 Groundwater

Groundwater from onsite water supply wells completed in the Upper Floridan aquifer will be used to supply general plant operations, including service-water cooling, potable-water supply, raw water to the demineralizer, fire protection, and media filter backwash (PEF 2009a). PEF has estimated that plant operations would require an average total withdrawal of 1.58 Mgd of groundwater from the Floridan aquifer and a potential maximum daily withdrawal of 5.8 Mgd (PEF 2009c).

PEF developed a local-scale groundwater flow model as a requirement of the LNP Site Certification Application to the State of Florida. This model, which was a local refinement of the Southwest Florida Water Management District's (SWFWMD) District-Wide Regulation Model, Version 2 (DWRM2) regional groundwater flow model, was used to simulate both LNP and cumulative groundwater-usage impacts (see Figure 2-12). SWFWMD staff provided technical guidance and peer review on development of the local-scale model and, once all identified technical deficiencies were resolved, issued a completeness determination that recommended authorizing the average and maximum daily usage values described (i.e., 1.58 and 5.8 Mgd, respectively), provided that State of Florida Conditions of Certification are met (FDEP 2010). As discussed in Section 2.3.1.2, this model was subsequently recalibrated to improve model fit in the vicinity of the LNP site.

PEF tested a number of wellfield locations and configurations using the model to evaluate potential drawdown impacts throughout the model domain. Based on this analysis, PEF determined that siting the wellfield in the southern portion of the proposed LNP property, where regional- and/or local-scale transmissivity is greatest, would reduce drawdown levels in both the Upper Floridan and surficial aquifers compared to siting wells in other feasible locations. Using this wellfield configuration, PEF performed predictive simulations of aquifer drawdown response to an annual average wellfield production rate of 1.58 Mgd (PEF 2009c).

Results from the predictive simulations indicate that annual average LNP groundwater usage from the Upper Floridan aquifer is minor relative to the overall model water balance (Figure 5-2). As indicated, average LNP operational usage (1.58 Mgd) represents only a small percentage (0.8 percent) of the total water flux (208 Mgd) through the model domain. At this withdrawal rate, the LNP wellfield is predicted to decrease the surficial and Upper Floridan aquifer discharge to surface waterbodies within the model domain by approximately 0.4 Mgd, or about 2 percent of the total simulated groundwater discharge to rivers and lakes. These simulated impacts on Lake Rousseau and the lower Withlacoochee River, which is designated as an Outstanding Florida Water, are minor relative to the 37-year recorded average daily discharge

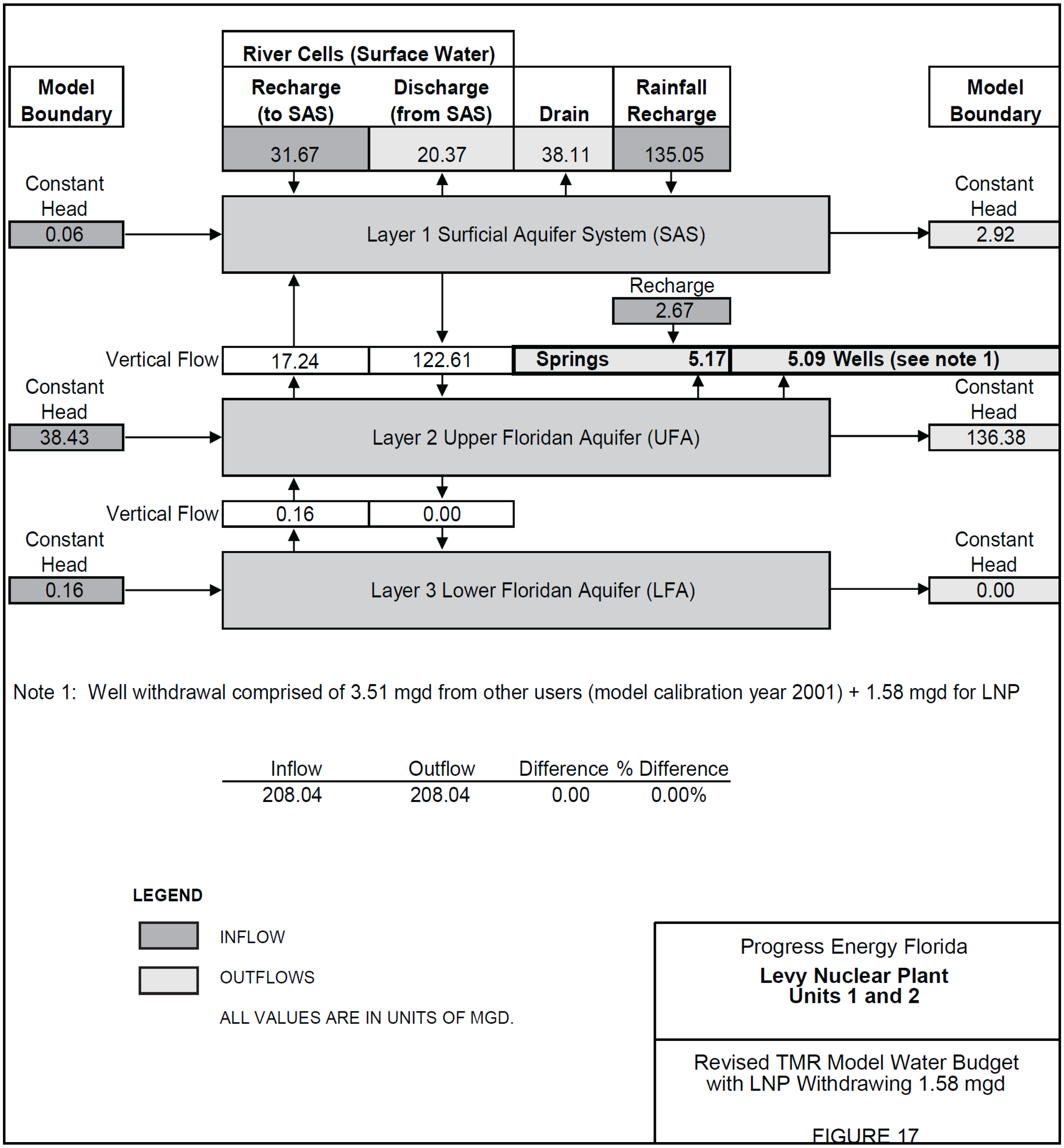

Figure 5-2. Local-Scale Groundwater Model Water Balance (PEF 2010a)

of 687 Mgd through the bypass channel to the lower Withlacoochee River. In addition, the groundwater model predicts that discharges to the two largest springs in the vicinity of the proposed LNP site, Big King and Little King Springs, would decrease by approximately 0.05 Mgd (35 gpm) or about 1 percent of their total simulated flux (PEF 2010a).

PEF predictive simulations indicate that operation of the LNP wellfield is not expected to adversely affect adjacent permitted users of the Upper Floridan aquifer. The model predicts less than 1 ft of additional drawdown response at the closest Upper Floridan aquifer user under annual average total LNP usage conditions of 1.58 Mgd. Under maximum daily usage conditions (5.8 Mgd) for a duration of 1 week, the model predicts that increased drawdown will not extend to the closest Upper Floridan aquifer well (i.e., permitted user).

Because LNP operational groundwater usage is minor relative to the overall model water balance, the staff concludes that operational groundwater-use impacts would be SMALL, and mitigation beyond the FDEP conditions of certification would not be warranted.

5.2.3 Water-Quality Impacts

This section discusses the impacts on the quality of water resources from the operation of proposed LNP Units 1 and 2. Surface-water impacts include thermal, chemical, and radiological wastes and physical changes in the Gulf of Mexico resulting from effluents discharged by the plant. Impacts on groundwater quality from saltwater intrusion are also assessed.

5.2.3.1 Surface Water

A conceptualization of the existing CFBC-Old Withlacoochee River (OWR) system is shown in Figure 5-3. The flow components that contribute to the hydrology of this system are the incoming and outgoing tides from the Gulf of Mexico, freshwater spring inflow into the CFBC near the base of the Inglis Dam and just below the Inglis Lock, some leakage of Lake Rousseau from the Inglis Lock, and periodic spillway discharge from the Inglis Dam.

Based on the U.S. Geological Survey (USGS) streamflow records, the minimum, mean, and maximum daily discharges at the Inglis Dam are 70, 424, and 6030 cfs, respectively (USGS 2009). The discharge at the Inglis Dam exceeds the mean discharge approximately 26 percent of the time.

The Cedar Key tide gauge is the nearest tide gauge and therefore its observations are used as representative of those at the mouth of the CFBC. The mean diurnal range at the Cedar Key, Florida, tidal gauge is 2.83 ft. Over a tidal cycle of approximately 12.5-hour duration (assuming starting the CFBC level at mean low water, rising to mean high water, and falling back to mean low water), the average flow into and out of the CFBC during the cycle can be approximated as $(0.5 \times (230\text{ ft} + 150\text{ ft}) \times 2.83\text{ ft} \times 7.0\text{ mi} \times 5280\text{ ft/mi}) \div (0.5 \times 12.5\text{ hr} \times 3600\text{ s/hr})$, or 883 cfs.

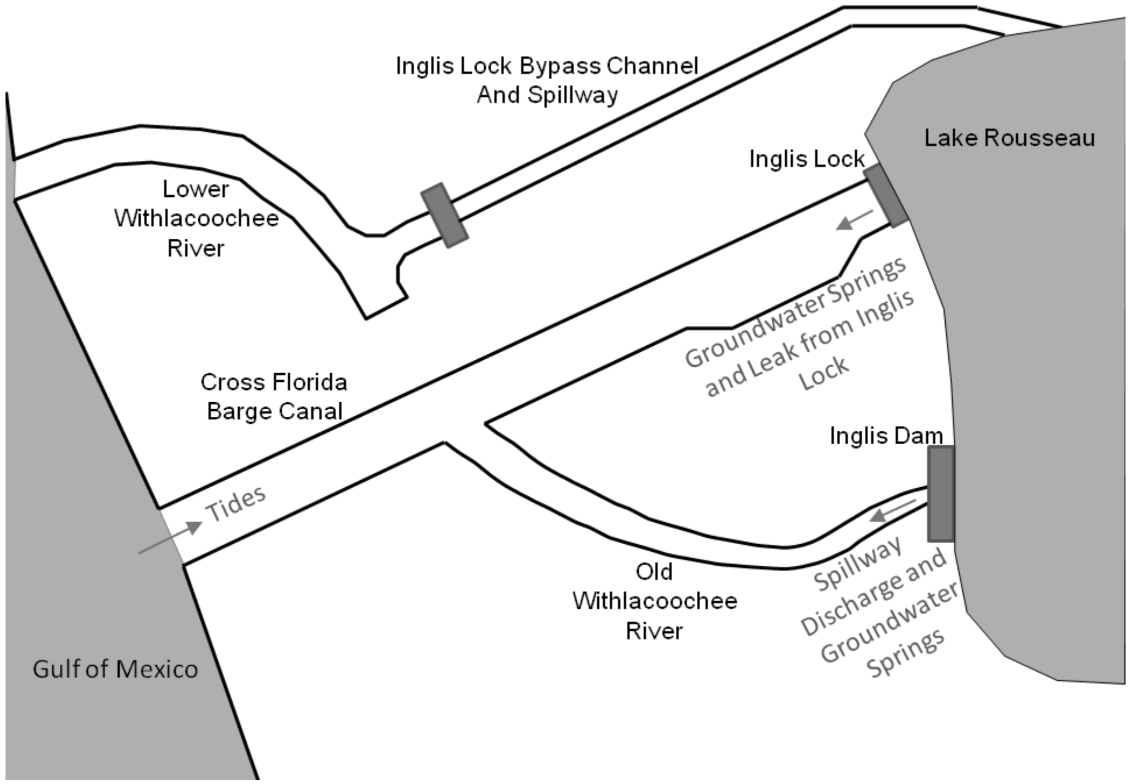

Figure 5-3. Conceptualization of Flow Within the CFBC-OWR System Under Existing Conditions (figure is not to scale)

The velocity for this average flow rate would be 0.39 fps or 4.6 in./s. The salinity at the confluence of the CFBC and the OWR depends on the freshwater discharge into the CFBC from the springs and any water released over the spillway of the Inglis Dam. Under current conditions, the CFBC starts to experience elevated salinity as a result of incoming tidal waters when the combined freshwater discharge from the Inglis Dam and spring inflow is smaller than 883 cfs, which occurs approximately 86 percent of the time.

Due to the operation of the proposed LNP intake, a net inflow to the CFBC from the Gulf of Mexico would occur (Figure 5-4). The net inflow into the CFBC has the potential to change the existing water quality in both the CFBC and the OWR. During operation of LNP Units 1 and 2, the CFBC-OWR system would be subject to the following fluxes: (1) a net intake of 122 Mgd (190 cfs) for normal plant operations, (2) discharge of leaked freshwater from the Inglis Lock and freshwater spring inflow just downstream of the Inglis Lock (estimated to be 50 cfs by PEF), and (3) discharge of freshwater from the Lake Rousseau spillway that enters the CFBC via the OWR. Freshwater is discharged from the Lake Rousseau spillway during flood events and, therefore, is intermittent. During low flow conditions (i.e., no discharge from Lake Rousseau spillway), the USGS estimated a seepage of freshwater into the OWR below the Inglis Dam of

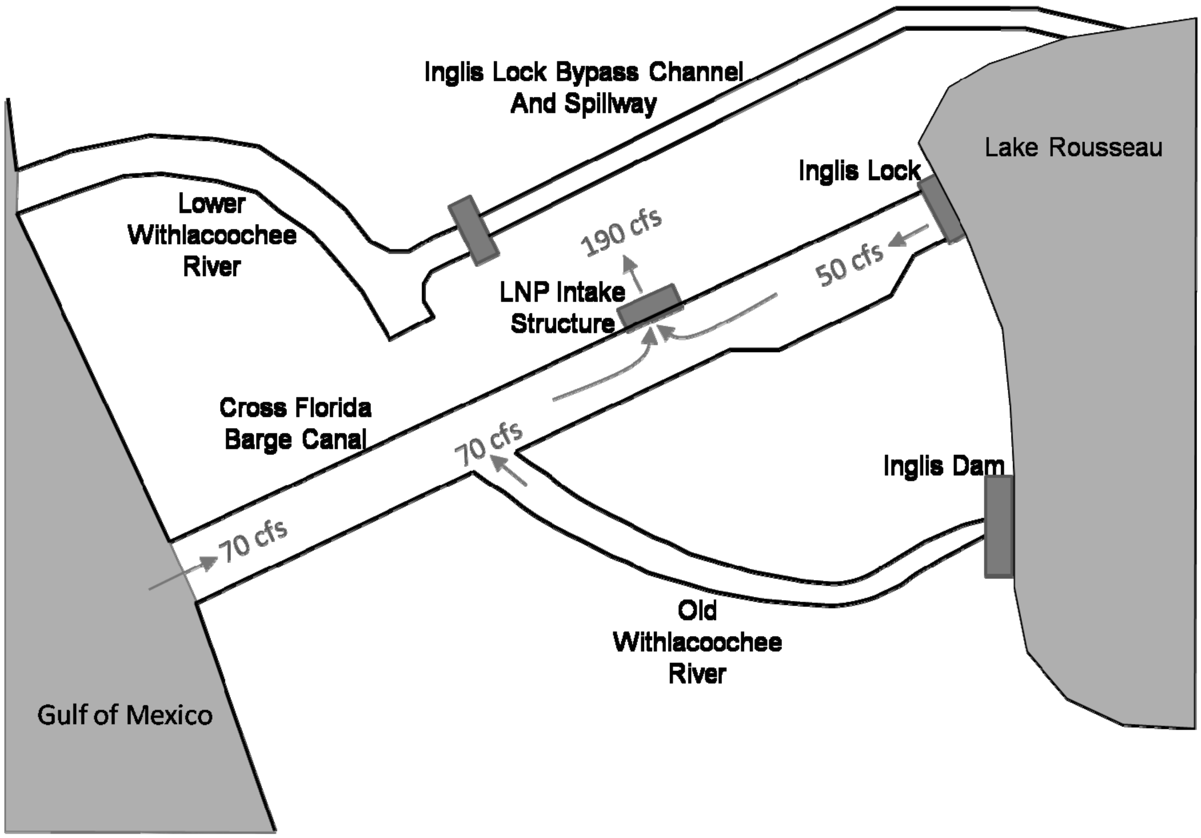

Figure 5-4. Conceptualization of Flow Within the CFBC-OWR System During Low Flows Ignoring Tidal Effects from the Gulf of Mexico (figure is not to scale)

70 cfs (USGS 2009). Figure 5-4 above shows the conceptualization of the CFBC-OWR system during low flows, ignoring any tidal effects from the Gulf of Mexico.

During low flows and ignoring the tidal cycle, an additional 70 cfs of inflow from the Gulf of Mexico would be needed to sustain the plant makeup-water intake of 190 cfs. In this scenario, the maximum flow within the CFBC would occur between the proposed LNP intake and the confluence of the OWR with CFBC. In this reach, the flow would be 140 cfs. The cross section of the CFBC has a top width of 230 ft, a bottom width of 150 ft, and an average depth of 12 ft. The corresponding maximum velocity induced by the operation of the proposed LNP intake would be 0.06 fps, or less than 1 in./s. The maximum velocity induced by the proposed LNP intake at the proposed intake location would be essentially unnoticeable. The salinity corresponding to seawater, 35 psu, would prevail under the low-flow condition from the mouth of the CFBC up to its confluence with the OWR. Assuming well-mixed conditions, the average salinity in the reach from the confluence of the CFBC and the OWR to the proposed LNP intake would be approximately 15 psu (weighted average of approximately 35 psu contributed by the

70 cfs inflow from the Gulf of Mexico and approximately 0 psu of the 70 cfs freshwater discharge from the OWR).

During operations of LNP units, the CFBC would start to experience elevated salinity as a result of incoming tidal waters when the combined freshwater discharge from the Inglis Dam and spring inflow is smaller than 1073 cfs, which would occur approximately 89 percent of the time. Currently, the CFBC experiences elevated salinity approximately 86 percent of the time. The CFBC-OWR system, during a tidal cycle with a mean diurnal range that may occur during low flow conditions, currently experiences seawater inflow that is more than 4.6 times the proposed LNP makeup-water withdrawal. The increment in velocity within the CFBC due to the operation of the LNP intake would be less than one-sixth of the average velocity of the incoming tidal waters during low-flow conditions.

The review team concludes that, for the reasons stated above, the additional LNP makeup-water withdrawal would not significantly alter the existing condition in the CFBC, and the impact on water quality of the CFBC due to operation of the LNP intake is expected to be minimal.

The OWR currently has a minimum discharge of approximately 70 cfs into the CFBC. This minimum discharge would not change due to operation of the proposed LNP units. The salinity within the OWR is controlled by the freshwater discharges from Lake Rousseau and the spring flow below Inglis Dam. Water-quality sampling performed by PEF on August 27, 2008 shows that during periods of high discharges from Lake Rousseau, the whole OWR can essentially become a body of freshwater (PEF 2009c; CH2M Hill 2009b). The mean daily discharge in the OWR below Lake Rousseau on August 27, 2008 was 1000 cfs (USGS 2009). The measurements performed by PEF at three locations in the OWR showed that depth-averaged salinities were 0.35 parts per thousand (ppt) near the confluence of the OWR with the CFBC, 0.34 ppt mid-way between the confluence of the OWR with the CFBC and Inglis Dam, and 0.34 ppt in the OWR just below Inglis Dam. The applicant also measured salinity at the three locations in the OWR on June 26, 2008. The depth-averaged salinity values at the same three locations were 4.38, 0.15, and 0.14 ppt with a corresponding mean daily discharge of 141 cfs (USGS 2009). The applicant reported that the saltwater intrusion into the OWR occurs in the form of a salinity wedge along the bottom of the profile with bottom salinity of 12.25 ppt on June 26, 2008 at the confluence of the OWR with the CFBC. The applicant also concluded that the salinity in the OWR just below the Inglis Dam remains less than 1 psu at all times.

Salinity measurements performed by PEF at four locations in the CFBC during October 18, 2007 and September 15, 2008, show a mean depth-averaged salinity of approximately 12 psu at the confluence of the OWR with the CFBC (PEF 2009c; CH2M Hill 2009b).

PEF performed a simplified analysis of salinity transport from the CFBC into the OWR during steady-state flow conditions (PEF 2009c; CH2M Hill 2009b). The analysis assumed that under steady-state conditions, tidal fluctuations would average to a net flow of zero, and the advective transport of salinity out of the OWR would be balanced by the diffusive transport into the OWR from the CFBC. PEF estimated the salinity at the upstream end of a reach using a finite difference form of the salt balance equation (Ficsher et al. 1979). The equation predicts the salinity at the upstream end of the reach using known flow velocity through the reach, salinity at the downstream end of the reach, length of the reach, and the longitudinal dispersion coefficient. Salinity at the upstream end of the reach becomes closer in value to that at the downstream end with decreasing velocity of flow and with an increasing dispersion coefficient.

Because measurement of the dispersion coefficient is not available for the OWR, PEF used observed salinity data to estimate a value of about 35 m^2/s (377 ft^2/s) assuming a 70 cfs flow in the OWR and a value of 50 m^2/s (538 ft^2/s) assuming a 100 cfs flow in the OWR. Experimental measurements of longitudinal dispersion coefficients in natural channels in the USA vary over a wide range, from 2 to 1500 m^2/s (22 to 16000 ft^2/s) (Kashefipour and Falconer 2002). Kashefipour and Falconer (2002) developed an empirical relationship using measurements that were shown to perform reasonably well. In the developed empirical relationship, dispersion coefficient is proportional to depth of flow and square of velocity and inversely proportional to shear velocity. Assuming a depth of 2 m (6.6 ft) and a width of 20 m (66 ft), the review team determined that the flow velocity in the OWR would be approximately 0.06 m/s (0.2 ft/s) at a discharge of 70 cfs. The review team used these values of depth, width, and velocity in the empirical relationship developed by Kashefipour and Falconer (2002). The shear velocity was assumed to be 0.1 m/s (0.33 ft/s), consistent with observed data presented by Kashefipour and Falconer (2002). The review team-estimated longitudinal dispersion coefficient for the OWR is 0.8 m^2/s (8.2 ft^2/s), which is significantly smaller than the values estimated by PEF using observed OWR salinity and flow data. Because salinity “transports” more quickly upstream with increasing values of the longitudinal dispersion coefficient, the review team determined that PEF’s estimation of salinity upstream in the OWR from the CFBC is conservative.

PEF estimated that at discharges of 70, 100, and 150 cfs through the OWR the salinity at the upstream end of the OWR or downstream of Inglis Dam would increase 1.2, 0.4, and 0.1 psu respectively, from existing conditions (PEF 2009c; CH2M Hill 2009b). Because the value of the longitudinal dispersion coefficient used by PEF is conservative, the review team determined that the upper reaches of the OWR would only experience minor increases in salinity.

Because of the operation of the proposed LNP discharge, the flow in the CREC discharge canal would increase from 1985.9 Mgd (CREC Units 1-5 discharge) to 2073.4 Mgd (CREC Units 1–5 plus LNP Units 1 and 2 discharge). The flow increase is approximately 4.4 percent greater than the existing discharge. The review team independently used the Finite Volume Coastal Ocean Model (FVCOM) (MEDM 2010; Chen et al. 2003, 2004) to estimate the properties of the discharge plume in the Gulf of Mexico. Table 5-1 lists the four configurations that resulted in eight simulated scenarios, one each for summer and winter conditions for each configuration. Configuration 1 serves as the baseline condition with only CREC Units 1 through 5 discharging to the Gulf via the CREC discharge canal. Configuration 2 added the LNP Units 1 and 2 discharges to the CREC discharge canal. Configuration 3 added the effects of the planned uprate to CREC Unit 3. Configuration 4 addressed the effects of a potential shutdown of CREC Units 1 and 2 once LNP Units 1 and 2 start operating.

Table 5-1. Thermal Plume Scenarios Simulated by the Review Team

	Discharge (Mgd)		Salinity (psu)		Discharge Temperature (Ambient Temperature)	
Configuration	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
1. CREC Units 1-5	1985.9	1985.9	35.8	35.8	96.5°F or 35.83°C (86°F or 30.0°C)	96.5°F or 35.83°C (58°F or 14.4°C)
2. CREC Units 1-5 plus LNP Units 1 and 2	2073.4	2073.4	36.5	36.5	96.4°F or 35.78°C (86°F or 30.0°C)	96.4°F or 35.78°C (58°F or 14.4°C)
3. CREC Units 1-5 with CREC Unit 3 uprate plus LNP Units 1 and 2	1948	1686	35.9	35.9	96.5°F or 35.83°C (86°F or 30.0°C)	96.4°F or 35.78°C (58°F or 14.4°C)
4. CREC Units 3-5 with CREC Unit 3 uprate plus LNP Units 1 and 2	1030	1052	36.6	36.6	96.4°F or 35.78°C (86°F or 30.0°C)	96.4°F or 35.78°C (58°F or 14.4°C)

Sources: PEF 2008e, 2009g, 2010b.

Bathymetry data used in model simulations were provided by PEF and the review team supplemented those data by using NOAA nautical charts and bathymetry data developed by USACE and the University of North Carolina (UNC 2010). Ambient salinity was assumed to be 35 psu and discharge salinities were calculated based on one cycle of concentration for once-through cooling discharge (CREC Units 1-3) and 1.5 cycles of concentration for closed-loop cooling discharges (CREC Units 4 and 5 and LNP Units 1 and 2). Ambient water temperatures were obtained from the NOAA tide gauge at Cedar Key.

Based on these simulations, the review team estimated the discharge plume temperature and salinity. The incremental impact of the addition of LNP Units 1 and 2 was estimated by maps of changes in water temperature and salinity. The maps show the changes from the baseline by subtracting the simulated plume property of Configuration 1 from that of Configuration 2. The maximum change in water temperature within the simulated plume was significantly smaller than 0.5°C in summer and slightly greater than 0.5°C in winter. The surface area where the Configuration 2 plume showed an increase in water temperature of 0.5°C or larger in winter was 38 km^2 (15 mi^2) in size. The discharge temperature during winter was set to the NPDES-permitted maximum during the review team's simulations. However, the discharge temperatures would be significantly smaller than the NPDES-permitted maximum in winter because the cooling water withdrawn from the Gulf of Mexico would also be cooler. Therefore, the incremental increase in plume temperature during winter estimated by the review team's simulations is a bounding estimate. Because the incremental increase in plume temperatures in the Gulf would be significantly smaller than 0.5°C in summer and is bounded by 0.5°C in winter, the review team concluded that the impact on plume temperature in the Gulf from operation of LNP Units 1 and 2 would be minimal.

The maximum change in salinity within the simulated plume was less than 0.8 psu in both summer and winter. The ambient salinity in the Gulf was assumed to be 35 psu. The review team concluded that the impact on plume salinity in the Gulf from operation of LNP Units 1 and 2 would also be minimal. Because the impact of operation of LNP Units 1 and 2 on water temperature and salinity in the Gulf near the discharge point would be minimal, the review team concluded that the impact of operation of LNP Units 1 and 2 on water quality in the Gulf would be minor.

A SWPPP and an erosion and sedimentation control plan, similar to those used at other large industrial facilities, would be in place during the operation of proposed LNP Units 1 and 2. During operation of Units 1 and 2, stormwater runoff from the LNP site would be routed through a series of drainage ditches to three stormwater detention ponds. The ponds would be designed to retain the volume of 25-year, 24-hour precipitation. The ponds would also be designed to drain within 5 days. Excess water from the precipitation events may be used to supply the cooling-tower basins and be partially discharged with the blowdown. For precipitation events exceeding the design storm, the detention ponds may overflow. The overflowing water would be spread out by spreader swales and run off to surrounding land as sheet flow. The overflowing water may partially infiltrate into the ground or discharge to Spring Run Creek from the northern portion of the site, to the Gulf of Mexico from the central portion of the site, and to the Withlacoochee River from a small southern portion of the site. These runoff contributions from the LNP site would be a small fraction of the three respective watersheds. Therefore, the impact on water quality from stormwater runoff is expected to be minor.

Based on the reviews and analyses described above, the review team determined the impact of operating LNP Units 1 and 2 on surface water quality of the CFBC, OWR, lower Withlacoochee River, and other nearby streams would be SMALL and mitigation beyond the FDEP conditions of certification would not be warranted.

5.2.3.2 Groundwater

Groundwater withdrawals from the Upper Floridan aquifer have the potential to lower potentiometric surfaces and induce saltwater intrusion. However, due to the relatively small amount of groundwater usage for proposed LNP operations compared to the overall groundwater system water balance, and the relatively small drawdowns (less than 2.5 ft) at the wells and progressively less farther away from the wells) predicted for the LNP wellfield (PEF 2009d), lateral saltwater intrusion from the CFBC is unlikely. Simulation results indicate that groundwater will continue to discharge to the CFBC (although at a somewhat reduced rate) rather than the canal acting as a recharge boundary for the groundwater system. The potential for vertical migration of saline waters from deeper Floridan aquifer intervals also exists at the site, although a low-permeability carbonate rock sequence (middle confining unit) that separates the Upper and Lower Floridan aquifers should act to limit vertical migration. A wellfield water-quality monitoring program would be instituted to detect any detrimental impacts, and wellfield operations would be managed to mitigate any significant decreases in water quality. Under these geohydrologic and operational conditions, the staff concludes that operational groundwater-quality impacts would be SMALL, and mitigation beyond the FDEP conditions of certification would not be warranted.

5.2.4 Water Monitoring

Section 6.3 of the ER (PEF 2009a) describes the hydrologic monitoring program that will be used to control potential adverse impacts of LNP operations on surface water and groundwater and identifies alternatives or engineering measures that could be implemented to reduce these impacts. Because this section primarily describes PEF’s plans for future monitoring, its language is based closely on PEF’s description of the monitoring program in the ER.

Because there are no freshwater streams on the LNP site, no operational monitoring of streams is necessary. The operations of LNP Units 1 and 2 would not affect the nearby Withlacoochee River, Waccasassa River, Spring Run, and Lake Rousseau. Water level data collected by USGS at the Inglis Dam would continue and be used to provide information regarding lake levels during operations of LNP Units 1 and 2. Quarterly preoperational monitoring of water level and bathymetry (water depth) of the CFBC at Stations 1-3 (see Figure 2-13) would start one year before LNP Units 1 and 2 begin operations. Daily water level measurements in the CFBC would also be carried out one year before LNP Units 1 and 2 start operating. Operational monitoring of the water level and bathymetry of the CFBC canal would occur monthly during the first two years after either unit begins operation, bimonthly for years 3 through 5, and quarterly after that. CFBC water level monitoring would continue at quarterly intervals during operations. Quarterly monitoring starting one year before LNP Units 1 and 2 become operational will be performed at CREC stations 1-4 (see Figure 2-14). Monthly monitoring at CREC stations 1-4 would continue during the first two years after either unit begins operation, bimonthly for years 3 through 5, and quarterly after that.

Most pre-application monitoring wells are located within the footprint of the proposed LNP construction area and would need to be decommissioned before construction activities begin. Hydrologic measurements in four pre-application monitoring wells located outside the construction area (MW-1S, MW-2S, MW-3S, and MW-4S) would continue throughout the construction, preoperational, and operational phases of the project. In addition, PEF proposes to install 43 additional monitoring wells during the preoperational phase of the project.

The groundwater monitoring efforts can be grouped by functional intent as follows: reactor area monitoring to establish background conditions and document changes in the immediate vicinity of the reactors, peripheral sentinel well monitoring to establish background conditions and document changes up- and down-gradient of the reactor units, and wellfield sentinel well monitoring to establish background conditions and document changes due to pumping of raw water from groundwater aquifers. Water levels in wells surrounding the reactor units would be monitored using automated pressure transducers to assess the impacts of surface alterations, drainage ditches, and water-retention ponds. Water levels in peripheral shallow and/or deep monitoring wells would be monitored monthly using manual water-level indicator measurements. Water levels in the wellfield sentinel wells would be monitored using automated pressure transducers to assess wellfield impacts.

Section 6.6 of the ER (PEF 2009a) describes the chemical monitoring program. The objective of chemical monitoring is to identify changes in water quality that may result from LNP operations. The chemical monitoring efforts can be grouped by the same functional intent as that described for the groundwater monitoring effort. Groundwater chemistry would be monitored quarterly in the four pre-application monitoring wells located outside the construction area (MW-1S, MW-2S, MW-3S, and MW-4S) and a total of 43 new monitoring wells installed immediately following construction activities and prior to plant operations. The frequency of groundwater chemistry monitoring would be monthly for the first year after initiation of plant operations and quarterly thereafter. The need for modifications to the monitoring program (e.g., sampling locations and frequency, analyte list, and analytical methods) would be routinely evaluated throughout the construction and preoperational monitoring programs. Sampling and analysis requirements for operational monitoring are currently planned to be the same as those specified for pre-application monitoring in ER Section 2.3.3.2 (PEF 2009a).

5.3 Ecology

This section describes the potential impacts on ecological resources from the operation of two new reactor units at the LNP site, as well as the operation of the associated offsite facilities, including new transmission lines. The operational impacts for terrestrial and wetland ecosystems are discussed in Section 5.3.1, and aquatic ecosystems impacts are addressed in Section 5.3.2. Evaluation of potential impacts on terrestrial and aquatic biota from radiological sources is discussed in Section 5.9.

5.3.1 Terrestrial and Wetland Impacts Related to Operations

Most impacts on terrestrial habitats and species related to the operation of proposed LNP Units 1 and 2 are expected to result from cooling-system operations, groundwater pumping, and the operation and maintenance of the transmission lines. Operation of the cooling system can result in local deposition of dissolved solids (commonly referred to as salt deposition); increased local fogging, precipitation, or icing; increased local noise levels; a risk of avian mortality caused by collision with tall structures; and hydrological changes to habitats adjoining the source waterbody. Groundwater withdrawals to support other plant operations (no groundwater would be withdrawn for the cooling system) may affect water levels in wetlands on and around the LNP site. Increased traffic and night-time lighting associated with operation may affect wildlife. These operational impacts are discussed further in Section 5.3.1.1.

Operation and maintenance of the transmission system may affect terrestrial species through collision mortality and electrocution, electromagnetic fields (EMFs), and vegetation maintenance in transmission-line corridors. Impacts of the transmission lines on terrestrial resources are discussed in Section 5.3.1.2. The potential effect of these operational impacts on important species and their habitats, including Federally and State-listed species, is addressed in Section 5.3.1.3.

As described in Chapter 3, the cooling system proposed for LNP Units 1 and 2 includes a series of mechanical draft cooling towers that would draw makeup water for cooling from the CFBC. This water would be mostly derived from shallow, nearshore waters of the Gulf of Mexico (PEF 2009a). The heat would be transferred to the atmosphere in the form of water vapor and drift. Vapor plumes and drift, including salts and other solutes in the drift, have the potential to affect crops, ornamental vegetation, and native plants. Water withdrawals would increase salinity levels in the CFBC and thereby alter shoreline habitat along the CFBC, including tidal marshes near the entrance of the CFBC to the Gulf of Mexico. In addition, bird collisions are possible with mechanical draft cooling towers and other tall structures, and wildlife can be affected by noise generated by the operation of cooling towers.

Groundwater from water supply wells located immediately south of the LNP site would be used to meet general plant operations. PEF (2009a) estimates that general facility uses would require normal daily withdrawal of about 1.58 Mgd of freshwater from the underlying Floridan aquifer. Since the surficial aquifer that supports local wetlands is hydrologically connected to the Floridan aquifer system, groundwater withdrawal from the Floridan aquifer system could affect wetlands on and around the LNP site.

Electric transmission systems have the potential to affect terrestrial ecological resources through corridor maintenance, bird collisions with transmission lines, and EMFs. Approximately 180 mi of new transmission lines (500 kV and 230 kV) would be required to incorporate power generated by the LNP into the Florida electric grid system. However, more than 90 percent of the new transmission lines would be collocated with existing PEF transmission lines (PEF 2009e).

5.3.1.1 Terrestrial Resources – Site and Vicinity

Impacts on the LNP site and vicinity from the proposed operation of two new units are described in this section. Vapor plumes and drift associated with the operation of two proposed mechanical draft cooling towers may affect vegetation such as native plant communities, managed tree farms, crops, and ornamental vegetation. Water-quality changes resulting from the withdrawal of cooling water from the CFBC could alter shoreline vegetation along the CFBC. Groundwater pumping to support general plant operations could affect hydrology that supports nearby wetlands. Bird collisions and noise-related impacts are possible with mechanical draft cooling towers and other facility structures. Increased traffic and nighttime lights associated with operation may also affect wildlife populations.

Impacts of Cooling-Tower Operations

Aspects of cooling tower operation recognized as potentially affecting crops, ornamental vegetation, and native plants include cooling-tower drift, icing, fogging, or increased humidity (NRC 1996, 1999[a]). No row crop agricultural land exists on or adjacent to the LNP site. However, forests (including managed and unmanaged forestland) and wetlands occur on and around the LNP site, and small areas identified as cropland and/or pastureland (FLUCFCS 210) and low-density residential (FLUCFCS 110) are situated near the LNP site.

A mechanical draft cooling tower associated with each proposed unit would be used to remove excess heat from the circulating-water system (CWS) by transferring it to the atmosphere. Through the process of evaporation, total dissolved solids (TDS) in the CWS are concentrated. A small percentage of the water in the CWS would unavoidably be released into the atmosphere

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[a] NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

as fine droplets (i.e., cooling-tower drift) containing elevated levels of TDS that can be deposited on nearby vegetation. Drift eliminators to be installed by PEF on the cooling towers are effective in reducing drift droplets to less than 0.1 percent of the drift loss expected without the eliminator (Young and Ciammaichella 2008). Operation of the CWS for the proposed LNP project would be based on 1.5 cycles of concentration, which means the TDS in the makeup water would be concentrated approximately 1.5 times before being released (PEF 2009e). CWS water losses from drift are minor in comparison to evaporation and blowdown discharge losses (PEF 2009a). When both mechanical draft cooling towers are operating under normal conditions, the maximum drift rate reported by PEF (2009a) for the proposed LNP is estimated to be 5.32 gpm.

Depending upon the source of makeup water, the TDS concentration in cooling tower drift can contain high levels of salts that damage exposed vegetation. Vegetation stress can be caused by drift with high levels of TDS deposition, either directly by deposition onto foliage or indirectly from the accumulation in soil (NRC 1996, 2000b). Makeup water would be brackish seawater drawn up the CFBC from shallow nearshore waters of the Gulf of Mexico. The concentration of TDS in the makeup water is expected to be around 25 ppt under normal operating conditions (PEF 2009a). PEF modeled the maximum predicted monthly average deposition rates for TDS using meteorological data from 2001 through 2005 (PEF 2009a). The maximum predicted onsite deposition during normal plant operation is predicted to be 10.75 kg/ha/mo of total solids, as determined from the 2004 meteorological data year. Isopleth maps showing modeled salt deposition in different meteorological data years are available in the ER (PEF 2009a). The maximum predicted offsite deposition rate would be 6.83 kg/ha/mo of total solids at the property boundary west of the cooling towers, as determined from the 2002 meteorological data year. Offsite deposition rates would decrease significantly with increasing distance from the proposed plant site, approaching one-third of the maximum offsite rate at 3280 ft from the site boundary (PEF 2009a).

NRC guidance for predicting the effects of salt drift deposition on plants indicates thresholds for visible leaf damage in the range of 10 to 20 kg/ha/mo during the growing season (NRC 2000a). A literature review discussing the responses of individual plant species to salt deposition is provided in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NRC 1996). Using a TDS deposition rate of 10 kg/ha/mo as a threshold limit above which adverse impacts on vegetation could occur, salt-drift modeling suggests that some vegetation on the LNP site could suffer leaf damage from salt drift in some years. As noted above, the maximum predicted onsite monthly salt deposition rate was 10.75 kg/ha/mo when modeled using the 2004 meteorological data year. This slightly exceeds the lower end (10 kg/ha/mo) of the range of salt deposition rates reported to cause visible leaf injury on vegetation. However, the maximum predicted onsite deposition rates for the 2001, 2002, 2003 and 2005 meteorological data years were below the threshold limit for leaf damage (PEF 2009e). Highest monthly average salt deposition rates are predicted to occur between March and September

(PEF 2009c). No adverse impacts on vegetation are predicted for lands outside of the LNP site because the maximum predicted monthly salt deposition rates for the 2001 through 2005 meteorological data years were all below the threshold limit for offsite lands (PEF 2009e). As noted above, the maximum predicted offsite rate was 6.83 kg/ha/mo for the 2002 meteorological data year.

Adverse impacts on vegetation from soil salinization are not expected to be an issue on or near the LNP site because sufficient rainfall would be received to leach salts from the predominantly sandy soil profile. Average annual precipitation for the region that includes the LNP site is approximately 53 in./yr (see Section 2.3.1.1 of the EIS); total rainfall recorded over a 1-year period (February 1, 2007 through January 31, 2008) at the LNP meteorological monitoring station was 43.0 in. (PEF 2009a). Potential soil salinization problems at energy facilities are generally limited to arid regions with lower rainfall (NRC 1996).

A variety of factors can influence plant response to salt drift, including species variability, plant phenology, duration and frequency of exposure, particle size, and chemical composition, as well as photoperiod, temperature, precipitation, and relative humidity during and after exposure (Simini and Leone 1982; McCune 1991). Onsite impacts from salt drift during LNP operation likely would be limited to vegetation close to the cooling towers (within 3280 ft), primarily in an area encompassing a northeast to southwest diagonal through the proposed cooling towers (PEF 2009e). This corresponds with the prevailing wind direction observed at the LNP site in 2007, and that recorded at Tampa, Florida (see Section 2.9.1.1 of this EIS). Much of the vegetation that could be affected by salt drift would be maintained and/or mowed vegetation around planned facilities. However, forested wetlands (FLUCFCS 617, 621 & 630), and pine plantation (FLUCFCS 441 & 629), much of which may be restored to native communities under the wetland mitigation plan (see Section 4.3.1.7), also lie near the proposed cooling towers. The potential for salt-drift impact on vegetation is expected to be moderated by the frequent rainfall the LNP site receives for much of the year (see Section 2.9.1.4), which would wash salt from the leaves and limit the duration of exposure. Precipitation in the region is particularly high during the summer months (4.3 – 9.8 in., June through September), although averages in other months usually exceed 2 in. (see Section 2.3.1.1 of the EIS). Considering that the maximum predicted monthly salt deposition rates for LNP operation did not exceed the threshold above which vegetation damage is generally noted in 4 of the 5 meteorological data years modeled (PEF 2009e), and that average precipitation levels range between 3.2 and 9.8 in. during months when highest deposition is predicted to occur, impact on vegetation from salt drift is expected to be minor, infrequent, and limited to the LNP site.

Results of a 14-year salt-drift monitoring study completed at the nearby CREC also support a conclusion that potential impacts on vegetative communities on the LNP site would be minor (PEF 2009a, e, f, h). CREC shares many of the same plant communities as the LNP site and vicinity, including coniferous plantations (FLUCFCS 441), wetland swamps (mixed wetland hardwoods – FLUCFCS 617, cypress – FLUCFCS 621, wetland forested mixed – FLUCFCS 630), and freshwater marshes (FLUCFCS 641). As a part of the CREC monitoring, vegetation was assessed monthly and quarterly for plant damage that could be attributed to salt-induced injury (e.g., browned leaf curl, marginal or tip necrosis, or shoot dieback). Salt deposition (sodium and chloride) was measured monthly using modified bulk precipitation collectors and periodically from samples of standing water. Deposition of salt on plant foliage was periodically measured, and aerial infrared photography was examined annually within a 1-mi radius of the CREC cooling towers for evidence of large-scale vegetation changes that could be attributable to salt-drift effects. Monitoring revealed increased salt deposition at the CREC during some months, with mean monthly salt concentrations generally encompassing a range (e.g., 1.7 kg/ha/mo to 19.8 kg/ha/mo in 1993 and 1994) (PEF 2009f) that includes the maximum predicted monthly salt deposition rates modeled for the LNP project. Minor vegetation damage to individual plants attributed to salt drift (e.g., chlorotic leaves or needles, leaf hypertrophy, tip or margin damage, or small or deformed leaves) was occasionally observed (PEF 2009e, f, h). Species common to both the CREC and the LNP site where salt drift damage to individual plants was noted include red maple, live oak, sweetgum, wax myrtle, Dahoon holly and grape vine, among several others. Although minor visible leaf damage was observed on individual plants, broadly visible damage to plant communities was not evident on and around the CREC that could be attributed to operation of the CREC cooling towers (PEF 2009e). Based on these findings, FDEP terminated the requirement for salt-drift monitoring at the CREC in 1996 (PEF 2009a, e).

Increased fogging and relative humidity near cooling towers have not been reported to affect native vegetation (NRC 1996). Ice-induced damage to native vegetation can occur but is rare, minor, and localized near cooling towers (NRC 1996), even in areas that experience longer and more frequent freezes than north Florida. Local climatological statistics for Tampa (located 78 mi south of the LNP site) indicate that freezing temperatures occur, on average, about 2 days per year along the west-central coast of Florida, generally in December, January (peak number), and February (NOAA 2010). Modeling of ground-level fogging and icing for the LNP site indicates no predicted instances of ground-level fogging or icing beyond 3280 ft from the nearest cooling-tower bank (PEF 2009a). Although ground-level fogging and icing may extend off the LNP site, no conservation lands in the site vicinity (e.g., the Goethe State Forest or Marjorie Harris Carr Cross-Florida Greenway) would be affected. Based on these data, impacts on surrounding vegetation from increased humidity and ground-level fogging or icing would be minimal.

A potential exists for cooling tower drift to increase the salinity of surface water in wetlands on the LNP site. Surface water is seasonally present within cypress domes and other freshwater swamps and wetlands on the LNP site, with water present year round in portions of some wetlands in some years. No baseline salinity measurements are available for LNP surface waters, but based on the dominant vegetation present, these waters are assumed to be fresh (i.e., salinities of less than 1 ppt). Using PEF's (2009a) maximum onsite salt drift deposition estimate of 10.75 kg/ha/mo and assuming the deposition is subjected to the lowest mean monthly precipitation of 1.62 inches as determined for the region (see Section 2.3.1.1), the review team estimated a conservative runoff salinity concentration of 0.026 ppt during cooling tower operation. Although evapotranspiration would contribute to the loss of (and thus increase in potential salt concentrations in) surface waters on the site, abundant precipitation (on the order of 53 in./yr) in the region would result in a dilution greater than that assumed above, and therefore the concentration estimated above is conservative. The potential for long-term concentration of salt in surface waters is expected to be limited by a significantly high exchange of water between the surface and groundwater systems, which occurs because of the lack of a confining geologic formation between the aquifer systems at the LNP site (see below and Section 2.3.1.2 for further discussion on groundwater conditions). Considering the very low additional contribution to surface water salinity from cooling tower drift and the low likelihood for substantial concentration of salts in surface waters, cooling tower drift is not expected to impair freshwater ecosystems on the LNP site.

Impacts on Wetlands from Stormwater Runoff and Groundwater Withdrawal

After site preparation and development are complete, numerous wetlands would remain in undeveloped areas on the LNP site (Figure 4-2). These wetlands would not be affected by stormwater runoff from impervious surfaces. Stormwater from the newly developed facilities would be collected through a stormwater-drainage system and directed into three stormwater-retention and/or infiltration ponds for treatment rather than into nearby wetlands (PEF 2009a). Stormwater runoff from roadways would be managed using a series of roadside swales. These unlined retention/detention facilities would allow for aquifer recharge of stormwater via infiltration. However, these and other wetlands on surrounding lands could be affected by groundwater withdrawals to support general facility operations.

Groundwater from water-supply wells located immediately south of the LNP site would be used to supply general plant operations, including service-water cooling, potable water supply, raw water to the demineralizer, fire protection, and media filter backwash (PEF 2009a). Groundwater in this portion of west-central Florida occurs in a surficial aquifer composed of unconsolidated sediments (primarily sands), and in an underlying carbonate rock aquifer known as the Floridan aquifer system. No confining geologic formation exists between these aquifer systems at the LNP site (i.e., they are hydraulically connected), and the surficial aquifer provides substantial recharge to the Floridan aquifer. The well field site was chosen to reduce drawdown levels in both the Upper Floridan and surficial aquifers compared to siting wells in other feasible locations. Although karst terrain (i.e., areas where underlying carbonate rock near the surface has been subjected to dissolution by downward infiltrating rainfall) is a problem in many areas of Florida, conditions near the LNP site (e.g., regional transmissivity values; few sinkholes) do not suggest well developed karst (see Section 2.3.1.2 of the EIS). Nevertheless, the cypress dome wetlands on site may represent karst development and likely provide for preferential recharge between the surface and groundwater (PEF 2009a). PEF (2009a) estimates that general facility uses would require normal daily withdrawal of about 1.58 Mgd of freshwater from the underlying Floridan aquifer. Because the surficial aquifer that supports local wetlands is hydrologically connected to the Floridan aquifer system in this area, groundwater withdrawal from the Floridan aquifer system could affect wetlands on and around the LNP site. Groundwater resources at the LNP are discussed in detail in Section 2.3.1.2.

PEF developed a local-scale groundwater model as a requirement of the facility's Site Certification Application to the State of Florida. The model, which is a submodel of the SWFWMD's DWRM2 regional groundwater flow model, was used to simulate both LNP and cumulative groundwater usage (PEF 2009g). Groundwater simulations using the DWRM2 model indicated a potential drawdown impact on the surficial aquifer on the order of 0.4 to 0.5 ft (4.8 to 6 in.) in areas immediately adjacent to wellheads over 60 years of groundwater pumping (Figure 5-5). The review team requested that PEF recalibrate the model using site-specific and regional hydraulic head data to improve the model's goodness of fit. A detailed description of this model and the recalibration process is provided by PEF in a response to requests for additional information (PEF 2009d). Predictive simulations using the recalibrated model indicate that annual average LNP groundwater usage from the Upper Floridan aquifer would, over 60 years of operation, result in surficial aquifer drawdowns of as much as 2.5 ft in areas near the wellheads, with a drawdown of 0.5 ft extending up to 3 mi from the wellheads (Figure 5-5). This groundwater drawdown zone would encompass about half of the LNP site and substantial offsite areas, including many acres of wetlands. See Sections 2.3.1.2 and 5.2.1 for further detail about the groundwater models and projected impacts on groundwater resources.

The recalibrated groundwater model for the LNP project predicts increased drawdown to the surficial aquifer from groundwater pumping over 60 years of operation. A review of the effects of groundwater drawdown on isolated wetlands in Florida suggests that extended drawdowns from 0.6 ft to 1 ft can result in substantial changes to vegetation composition and structure, and that a 1-ft decline can adversely affect seasonally and semi-permanently flooded wetlands (Mortellaro et al. 1995). Table 5-2 presents a breakdown by FLUCFCS cover classes of wetlands that lie within groundwater drawdown zones exceeding 0.5-ft. To maintain consistency, and because of difficulty in rectifying the boundaries for delineated wetlands on the LNP site with adjacent undelineated wetlands, this analysis is based solely upon SWFWMD map files dated 2007, and thus represents an index to potential wetland drawdown impacts. Using the recalibrated groundwater model, up to 2092.9 ac of wetlands could be adversely affected over 60 years of groundwater pumping to support the LNP project, with 563.4 ac occurring within groundwater drawdown zones that exceed 1 ft. No wetlands would lie within groundwater drawdown zones exceeding 0.5-ft under the original DWRM2 model prepared by PEF.

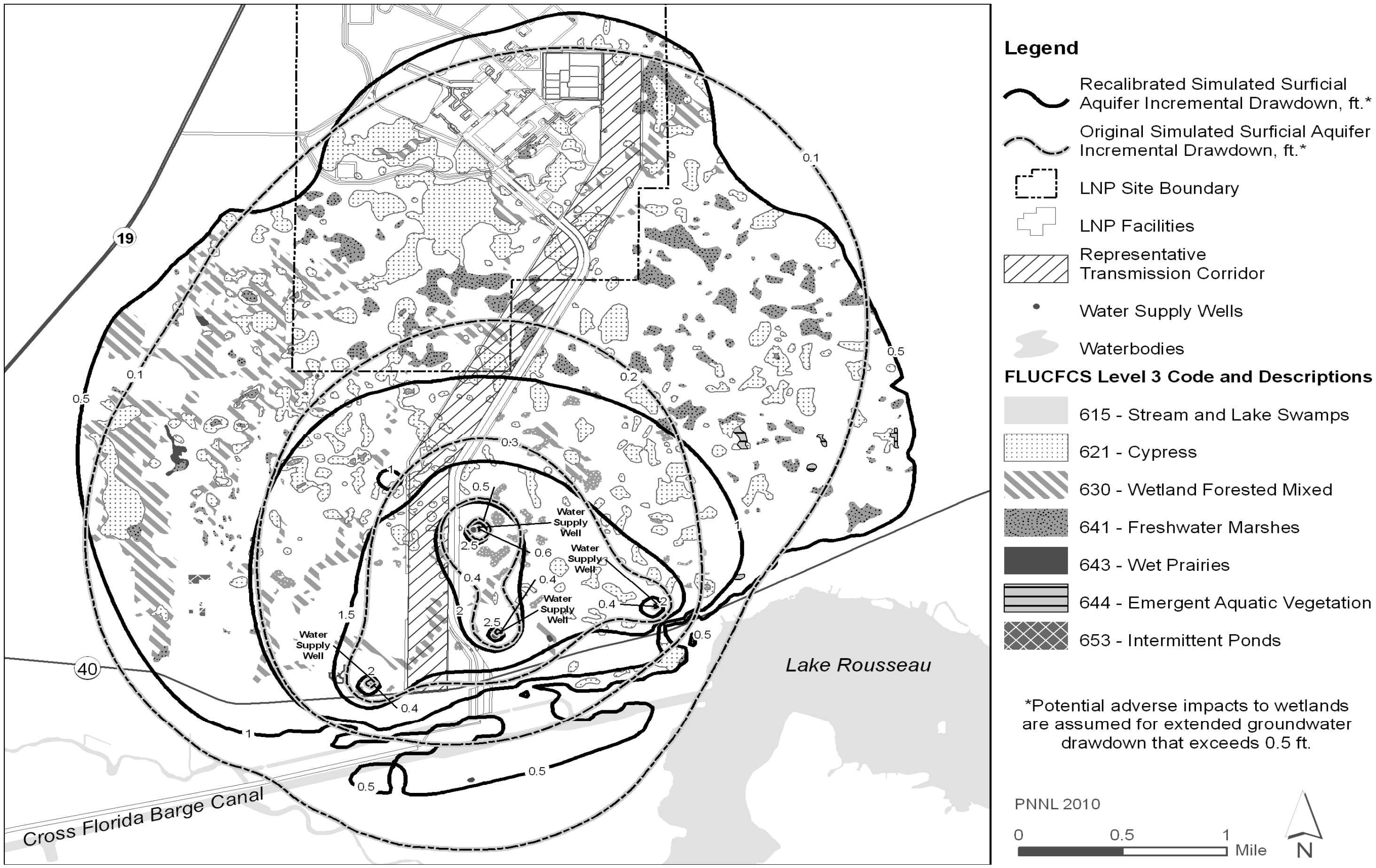

Figure 5-5. Simulated Groundwater Drawdown from Operational Pumping (1.58 Mgd at Year 60) Relative to Wetlands on the Well-Field Site (original DWRM2 model and the recalibrated model)

Table 5-2. Potential Wetland Impacts by FLUCFCS Cover Types for Simulated Groundwater Drawdown (1.58 Mgd at Year 60) Using the Recalibrated Groundwater Model

Wetland Cover Type	FLUCFCS Code[(a)]	Surficial Aquifer Drawdown Contour	Area (acres)[(b)]
Cypress	621	2 ft+	6.7
Wetland Forested Mixed	630	2 ft+	11.8
Freshwater Marshes	641	2 ft+	17.0
2+ ft Subtotal			35.5
Cypress	621	1.5 ft to 2 ft	70.2
Wetland Forested Mixed	630	1.5 ft to 2 ft	63.4
Freshwater Marshes	641	1.5 ft to 2 ft	18.6
Wet Prairies	643	1.5 ft to 2 ft	2.6
1.5 – 2 ft Subtotal			154.8
Cypress	621	1 ft to 1.5 ft	230.0
Wetland Forested Mixed	630	1 ft to 1.5 ft	105.1
Freshwater Marshes	641	1 ft to 1.5 ft	34.1
Wet Prairies	643	1 ft to 1.5 ft	2.0
Emergent Aquatic Vegetation	644	1 ft to 1.5 ft	1.9
1 – 1.5 ft Subtotal			373.1
Streams and Lake Swamps (Bottomland)	615	0.5 ft to 1 ft	2.2
Cypress	621	0.5 ft to 1 ft	710.4
Wetland Forested Mixed	630	0.5 ft to 1 ft	466.0
Freshwater Marshes	641	0.5 ft to 1 ft	332.5
Wet Prairies	643	0.5 ft to 1 ft	7.5
Emergent Aquatic Vegetation	644	0.5 ft to 1 ft	7.2
Intermittent Ponds	653	0.5 ft to 1 ft	3.7
0.5 – 1 ft Subtotal			1529.5
Total Area			2092.9

Sources: PEF 2009a; SWFWMD 2007; Overlay of recalibrated groundwater model onto LNP FLUCFCS vicinity map (PEF 2009k) prepared by PNNL in April 2010.
(a) FLUCFCS = Florida Land Use, Cover and Forms Classification System (FDOT 1999).
(b) For consistency and because of difficulty in rectifying the boundaries of LNP-delineated wetlands with adjacent undelineated wetlands, potential wetland drawdown impacts are based upon FLUCFCS cover classes as derived solely from SWFWMD (2007) mapping.

Groundwater models provide an objective means of predicting the effects of water withdrawal on groundwater resources, which, in turn, can be used to infer potential wetland impacts from groundwater pumping. Nevertheless, groundwater models are subject to many limitations and their results should be viewed with a degree of uncertainty. For example, the uncertainty in hydraulic property values at the proposed LNP wellfield demonstrates how differences in model values can substantially influence the assessment of wetlands impacts (i.e., the original Levy DWRM2 groundwater model compared to the recalibrated groundwater model).

Because of this uncertainty, and to ensure that the proposed use of groundwater for the LNP project does not cause adverse impacts on wetlands and surface waters, the State of Florida imposed the following conditions in the final site certification issued under the PPSA (FDEP (2010), to which PEF has committed:

- Aquifer Performance Testing (APT) Plan that includes hydraulic testing during drilling and construction of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater usage impacts without significantly affecting water levels in the surficial aquifer.
- Alternative Water Supply Plan to investigate the feasibility of developing alternative water supply projects to offset groundwater use.
- Environmental Monitoring Plan (based on the SWFWMD Wetland Assessment Procedure) to assess the relative biological and physical condition of surface waters and wetlands in areas potentially affected by groundwater withdrawals.

In accordance with SWFWMD's review criteria, groundwater withdrawal cannot cause unacceptable adverse impacts on wetlands or other surface waters. The SWFWMD performance review standards applicable to the Environmental Monitoring Plan, upon which potential impacts on wetlands would be judged, include the following (as summarized from PEF 2009h):

- Wet season water levels shall not deviate from their normal range;
- Wetland hydroperiods shall not deviate from their normal range and duration to the extent that wetlands plant species composition and community zonation are adversely affected;
- Wetland habitat functions, such as providing cover, breeding, and feeding areas for obligate and facultative wetland animals, shall be temporally and spatially maintained and not adversely affected as a result of withdrawals; and
- Habitat for threatened or endangered species shall not be altered to the extent that use by those species is impaired.

Considering the uncertainty associated with existing groundwater modeling for the LNP site, operational impacts from groundwater withdrawal to wetlands on and around the LNP site could affect the hydrological and hence ecological properties of wetlands within a localized area (see Table 5-2 and Figure 5-5). However, if adverse environmental impacts on wetlands and surface waters are predicted or detected through wellfield APT, revised groundwater modeling, or environmental monitoring of wetlands, PEF would be required either to mitigate the adverse impacts or implement an approved alternative water-supply project (FDEP 2010).

If PEF chooses to address any wetland impacts from groundwater withdrawal by mitigation rather than implementing an alternative water-supply project, it is unlikely that these hydrological alterations would contribute to an increased risk of wildfire in the LNP vicinity. Groundwater drawdown exceeding 0.5 ft that could adversely affect wetlands would be localized, and limited to a total area (upland as well as wetland) of about 7344 ac based upon the recalibrated groundwater model (Figure 5-5). Furthermore, the fire risk in parts of the surrounding area would be reduced through the restoration of a more natural fire regime, as proposed under the wetland mitigation plan for the LNP project (Entrix 2010). These controlled burns would act to reduce fuel loads in upland and wetland areas on and around the LNP site. If wildfires unexpectedly occur around the LNP project, rapid fire response would be expected, drawing from both onsite (LNP) and offsite fire-protection resources.

Bird Collisions with Cooling Towers and Structures

Avian mortality can result from collision with tall structures at nuclear power plants. Typically, the cooling tower and meteorological tower are the structures posing the greatest risk (NRC 1996). Two banks of mechanical draft cooling towers (each 1190 ft long, 97 ft wide, and 56 ft high) are proposed for the LNP, one for each generating unit (LNP Units 1 and 2) (PEF 2009a). With a height of only 56 ft, bird collision mortality would be substantially less likely than with the natural draft cooling towers present at many other power plant sites that can approach 500 ft in height. It is also possible that noise generated by the cooling towers may act to limit the potential for avian collision with these structures. In a review of bird collisions with cooling towers at nuclear plants, the NRC (1996) determined that avian mortality was negligible for mechanical draft cooling towers. The meteorological tower, a 198-ft high guyed, open lattice structure (PEF 2009a), could also represent a low-risk collision hazard for birds. The meteorological tower is located about 0.9 mi west-southwest of the proposed locations of LNP Units 1 and 2 and has been in operation since February 2007. Data available for communication towers indicate that tall towers more than 1000 ft in height pose the greatest collision risk for birds (Manville 2005). Published accounts of bird strikes and kills at shorter towers are limited, but assumed to occur less frequently. At 225 ft in height, the containment buildings represent the tallest structures proposed for the LNP site (PEF 2009a) and may constitute a low-risk collision hazard for birds.

Even if collisions occur with LNP structures, thriving bird populations can usually withstand the losses without threat to their existence (EPRI 1993). The NRC has previously concluded that avian collisions are unlikely to pose a biologically significant source of mortality because only a small fraction of total bird mortality has been attributed to collision with nuclear power plant structures (NRC 1996). Therefore, mortality from birds colliding with structures, including the cooling towers, containment buildings, and the meteorological tower, is expected to be undetectable at a population level for common bird species. Impacts on populations of less common bird species however, may be more substantial. Nonetheless, because none of the potentially affected bird species are endemic to the LNP vicinity, it is unlikely that the collision impacts would pose a risk to the overall survival of any avian species, including the less common species.

Bat mortality from collisions with LNP structures, such as the cooling towers, containment buildings, and the meteorological tower, is also expected to be undetectable at a population level. Except for bat mortality associated with wind turbines at wind energy facilities, bat collisions with tall man-made structures are rarely reported (Cryan and Barclay 2009; Erickson et al. 2002; Evans-Ogden 1996).

Noise Impacts of Operation

The dominant sources of noise likely to affect wildlife during normal operation of the proposed LNP would be the mechanical draft cooling towers and the main transformers. Other plant equipment capable of generating relatively high noise levels would be located within buildings or noise-attenuating structures. Outdoor noise levels on the LNP site are predicted to range from 90 dBA near the loudest equipment to 65 dBA in areas more distant from major noise sources (CH2M Hill 2008). Noise modeling predicts no perceptible, or perhaps very slight increases in noise from LNP operations at the site boundary (CH2M Hill 2008). Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 80- to 85-dB threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Large expanses of available habitat would remain on and around the LNP site into which mobile wildlife species could seek refuge if disturbed. Some resident wildlife could be expected to habituate to higher noise levels that typically produce startle responses.

Wildlife may also be affected by noise “masking” important sounds to which the animal would typically react if heard (e.g., the approach of a predator). Noise masking is, perhaps, a more serious concern than sounds that induce a behavioral (startle) response and cause the animal to flee from the sound source (Dooling 2002). Some level of noise masking is likely to occur on the LNP site, particularly at frequencies above 2 or 3 kHz. The loss of individuals due to this phenomenon would be localized and should have minimal impact on overall population health. Noise from plant operation would be partially attenuated by surrounding forest cover, and noise impacts off the LNP site are expected to be minimal to negligible.

CFBC Shoreline Habitat

Water pumped from the CFBC would be used as makeup water to replenish water lost by the LNP CWS to evaporation, blowdown, and drift. The LNP makeup-water pump house would be located approximately 6.9 mi from the Gulf of Mexico on the north side of the CFBC. Because the Gulf of Mexico essentially represents an unlimited source of water even during drought conditions, withdrawal is predicted to have a negligible effect on water levels in the CFBC (PEF 2009a). However, it is anticipated that higher-salinity water from the estuarine portions of the nearshore Gulf of Mexico would be slowly drawn up the CFBC toward the intake structure during operations. These water-quality changes could result in minor changes to shoreline vegetation along the CFBC, perhaps causing establishment of brackish water vegetation in some areas presently supporting freshwater vegetation.

The review team examined shoreline vegetation along the CFBC in December 2008 as part of the site audit for the LNP project. Currently, emergent vegetation is sparse along the excavated rocky shoreline of the CFBC upstream (east) of the U.S. Highway 19 (US-19) bridge. Downstream (west) from the bridge where the rocky shoreline is less pronounced, cordgrass (*Spartina* spp.) and other salt-marsh species slowly increase in density toward the Gulf of Mexico. The projected increase in salinity during operation could expand the distribution and density of salt-marsh species such as cordgrasses within the narrow emergent zone of the CFBC. The salinity increases within the CFBC should have no effect on upland vegetation growing on the slopes above the CFBC channel because the CFBC does not serve as a source of water for these species. Consequently, the potential effects on terrestrial habitats from the withdrawal of water from the CFBC would be negligible.

The CFBC provides foraging habitat for many species of birds, including bald eagles, ospreys, herons, gulls, and waterfowl, as well as resting habitat for waterfowl and other water birds. Sampling in the upper reach of the CFBC near the proposed cooling-water intake structure (CWIS) has revealed a biologically depauperate environment with relatively poor water quality (PEF 2009a). However, once the CWIS is operational, the upper reach near the intake would experience increased salinity concentrations and dissolved oxygen levels. The resulting overall improvement in water quality due to increased dissolved oxygen levels may support a greater diversity and abundance of marine and estuarine aquatic life including benthic invertebrates, fish, and crustaceans that serve as food sources for wildlife (PEF 2009a). These improvements in water quality and biodiversity may possibly be beneficial to wildlife that forages in the upper reach of the CFBC.

Impacts of Increased Vehicle Traffic

Increased traffic associated with operation of proposed LNP Units 1 and 2 may result in increased wildlife mortality from vehicle-wildlife collisions. An estimated 773 workers employed to operate proposed Units 1 and 2 would access the site the first year both units are operational (PEF 2009a). During periodic refueling outages planned for every 18 months, an additional 800 workers would be onsite for about 25 to 30 days (Kimley-Horn 2009). The operations workforce would access the site primarily via US-19, a four-lane divided highway. The additional traffic on highways and rural roads in the project vicinity would contribute to an incremental increase in traffic-related wildlife mortalities. Local wildlife populations could suffer declines if road-kill rates were to exceed the rates of reproduction and immigration. Although road-kills occur frequently, they generally have minimal impact on most wildlife populations (Forman and Alexander 1998). Consequently, the review team concludes that these impacts would not be detectable beyond the local vicinity and would not destabilize regional wildlife populations.

Light Pollution During Facility Operation

Light pollution during facility operation could affect wildlife residing on or migrating through the LNP site. Research has shown that artificial nighttime lighting can alter behaviors, foraging areas, and breeding cycles of a wide variety of wildlife, including insects, turtles, frogs, birds, and bats (Chepesuik 2009). The behavior of night-migrating songbirds can be disrupted by nighttime lighting systems, particularly during inclement weather. Night-migrating birds navigate using a combination of light from the moon and stars, as well as geomagnetic signals from the earth (Able 1980). Light pollution can obscure these natural visual cues, and red light commonly used on towers and other tall structures may interfere with the birds' abilities to track geomagnetic cues. Possible mitigation measures could include the use of lower-wattage lights, hooded or down-turned lights, and turning unnecessary lights off at night to minimize potential impacts on wildlife. If appropriate mitigation measures are taken, the impacts from light pollution on wildlife would be expected to be minimal.

5.3.1.2 Terrestrial Resources – Associated Offsite Facilities

Approximately 180 mi of new transmission lines spanning 148 mi of corridor (multiple lines in some corridors) would be required to incorporate the power generated by the proposed LNP project into the Florida electrical grid system (Golder Associates 2008; CH2M Hill 2009a). PEF expects to acquire a 220-ft-wide right-of-way for the proposed 500-kV transmission lines and a 100-ft-wide right-of-way for the proposed 230-kV transmission lines. More than 90 percent of the new transmission lines proposed for the LNP project would be collocated with existing PEF transmission lines (PEF 2009e). Site-preparation and site-development impacts on terrestrial resources resulting from this action are discussed in Section 4.3 of the EIS. Impacts related to maintenance and operation of the new transmission lines are discussed as follows. Unless specifically noted, these operational impacts would be similar for transmission lines up to the first substations and lines extending beyond the first substations.

Impacts from Transmission-Line Maintenance

The primary transmission-line corridor maintenance activity that may affect terrestrial resources is vegetation control. Transmission-line rights-of-way must be kept clear of woody growth through maintenance practices that prevent it from becoming a safety hazard or potentially interrupting service. The collocation of new transmission lines with existing PEF lines would minimize the area of new land that would need to be cleared of vegetation and subsequently maintained for the proposed LNP project. In areas where new corridors are required to accommodate the transmission lines, established maintenance procedures for power transmission systems would be followed to control vegetation, with a goal of maintaining a sustainable groundcover of low-growing, non-woody species (PEF 2009f). The vegetation management practices within rights-of-way owned by PEF are summarized from Golder Associates (2008) and PEF (2009a, f). These management practices may differ on rights-of-way where PEF is granted an easement by the landowner.

Maintenance needs within transmission-line corridors would be identified using regular ground patrols and periodic helicopter overflights. Vegetation maintenance within the corridors would include mechanical and chemical control methods appropriate for the location, terrain, and vegetation or habitat present. Mechanical methods of vegetation control may consist of hand clearing, mowing, pruning, and tree removal. Pruning would be performed along corridor edges to remove any overhanging branches in the right-of-way. Danger trees (any dead, diseased, damaged, or leaning trees that could interfere with or endanger the transmission lines and related facilities) would be removed on an as-needed basis. Chemical methods of vegetation control include the use of herbicides registered by the EPA and approved by the State of Florida. Herbicide use would be in accordance with manufacturer specifications and carried out by licensed applicators.

Vegetation management within wetlands would follow the same restrictive vegetation-clearing practices described in Section 4.3.1.2. These practices include hand clearing with chain saws or use of low-ground pressure shear or rotary machines to reduce soil compaction and limit vegetation damage. Vegetation management within wetlands under transmission lines would be intended to encourage herbaceous and low-growing woody vegetation that does not exceed 12 ft in height at maturity. Whenever maintenance is required in wetlands and other environmentally sensitive areas not served by access roads or fill pads, temporary matting would be used as necessary to minimize damage to wetland soils.

These vegetation-maintenance practices could result in mortality to less mobile animals, such as reptiles, amphibians, and small mammals that are unable to escape mowers, vehicles, and other equipment. If vegetation maintenance occurs during the spring and/or early summer nesting period, ground-nesting bird nests could be disturbed or damaged. Noise and human presence may temporarily displace wildlife from the corridors until disturbing activities are completed. In general, these impacts are considered to be minor. Maintenance of early successional habitat and habitat edge (i.e., forest and/or clearing interface environments) within transmission-line corridors would be beneficial to wildlife favoring these habitats. Species expected to benefit include the white-tailed deer (*Odocoileus virginianus*), eastern cottontail rabbit (*Sylvilagus floridanus*), red-tailed hawk (*Buteo jamaicensis*), northern bobwhite (*Colinus virginianus*), northern cardinal (*Cardinalis cardinalis*), eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*), among others. The brown-headed cowbird

(*Molothrus ater*), a bird species that thrives along forest edges and parasitizes songbird nests (Cornell 2008), may also increase its presence due to corridor maintenance. This could lead to a decline in reproductive success of host songbird populations on and around the corridors.

Typical line-maintenance operations that could affect terrestrial resources may include insulator replacements, conductor repairs, shield wire repairs, grounding, and other activities associated with structures, conductors, and foundations (PEF 2009a, Golder Associates 2008). Noise and disturbance associated with these activities could result in minor, temporary impacts on wildlife near the transmission-line corridors. Only vehicular traffic necessary for routine PEF maintenance activities would be allowed within the corridors (PEF 2009a). Locked gates would be provided where transmission-line access roads intersect fenced property.

The impact of transmission-line corridor maintenance on wildlife and habitats, including wetlands, was evaluated by the NRC and found to be of small significance at operating nuclear power plants with associated transmission-line corridors of variable widths (NRC 1996). PEF would limit the extent of new transmission-line corridors requiring maintenance through collocation with existing corridors and has procedures in place that would minimize adverse impacts on wildlife and wetlands. Consequently, the review team concludes that potential effects on terrestrial ecology from maintenance practices within the new transmission-line corridors would be minor, and mitigation beyond the use of standard BMPs and the implementation of the wetland mitigation plan (see Section 4.3.1.7) would not be warranted.

Avian Mortality Impacts from Power Transmission

Transmission-line structures, conductors, and guy wires pose a potential avian collision hazard for resident birds that live in the vicinity of the transmission lines and for migratory birds that may pass through these areas. A branch of the Eastern Atlantic Flyway that crosses Florida intercepts portions of the proposed transmission lines (FWS 2010, Birdnatuare.com 2009). Potential LNP transmission-line structures include single steel pole or tubular steel H-frame designs supported on engineered foundations. Typical structure heights range from 60 to 195 ft with typical span lengths between structures of 300 to 1500 ft (PEF 2009a; Golder Associates 2008). The transmission structures normally carry a single circuit line consisting of three phases of triple-bundled aluminum conductors, steel reinforced, and two shield wires. Phase spacing is typically 34 ft. Because these higher voltage transmission structures require longer insulator strings and greater conductor clearances, avian electrocutions rarely occur (Harness 1996).

Transmission-line strikes are one of many human-caused sources of avian mortality in the United States (FWS 2002). Generally, collision mortality appears to represent only a small fraction of total avian mortality, and the NRC (1996) has concluded that bird collisions with transmission lines at existing U.S. nuclear power plants are of small significance, including transmission-line corridors with variable numbers of transmission lines. Because more than

90 percent of the new transmission lines proposed for the LNP project would be collocated with existing PEF transmission lines, either immediately adjacent to existing rights-of-way or within existing rights-of-way, few new rights-of-way would present new hazards for bird collisions. The greatest risk for avian collision is likely to occur for heavy, less agile birds, such as waterfowl and large wading birds (NRC 1996). The greatest concentrations of waterfowl and wading birds are expected to occur near streams, large lakes, wetlands, and known roost sites. New transmission lines near Lake Rousseau and crossing the CFBC and the remnant reach of the Withlacoochee River could pose a higher risk potential for these species. Raptors, such as red-shouldered hawks (*Buteo lineatus*) and red-tailed hawks, have the potential to occur along most portions of transmission lines, where they would likely hunt for prey. Osprey (*Pandion haliaetus*) and bald eagles (*Haliaeetus leucocephalus*) are prevalent near the coast and around most large waterbodies that provide a reliable source of fish as prey. These large raptors may also be susceptible to collision hazards, particularly juvenile raptors that have recently fledged.

A condition of certification by the FDEP (2010) would require PEF to prepare an Avian Protection Plan in coordination with the Florida Fish and Wildlife Conservation Commission (FFWCC) and the U.S. Fish and Wildlife Service (FWS). The plan would seek to reduce the operational risk to birds posed by the LNP transmission lines and other electric utility facilities, with the goal of reducing avian mortality. The specific mitigation measures to be included in the plan would be developed concurrently with final design of the transmission lines and siting of the structure locations. Pursuant to PPSA, the final rights-of-way for the transmission lines are determined through a post-certification process.

The addition of new transmission lines and corridors may lead to an incremental increase in number of bird collisions during LNP operation. However, it would not be expected to cause a measurable reduction in bird populations. Consequently, the review team concludes that potential for impacts on birds due to collision with transmission lines for the proposed LNP project would be minimal, and additional mitigation beyond the Avian Protection Plan would not be warranted.

Impacts of Electromagnetic Fields on Flora and Fauna

EMFs are unlike many other agents that have an adverse impact (e.g., toxic chemicals, ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996). As discussed in the Generic Environmental Impact Statement (GEIS) for license renewal (NRC 1996), a careful review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. Operating power transmission lines in the United States produce EMFs of nonionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF) EMF. The transmission lines connected to the proposed reactors would be 500 kV and 230 kV. The EMFs produced by operating transmission lines up to 1100 kV have not been reported to have any biologically or economically significant impacts on plants, wildlife, agricultural crops, or livestock (Lee et al.

1989; Miller 1983). Minor damage to plant foliage and buds can occur near strong electric fields, caused by heating of the leaf tips and margins. Damage does not appear within the main stem and root systems of the plants and would not significantly affect growth (NRC 1996).

The conclusion presented in the GEIS for license renewal (NRC 1996) was that the impacts of EMFs on terrestrial flora and fauna were of minimal significance at operating nuclear power plants, including transmission systems with variable numbers of transmission lines. Since 1997, more than a dozen studies have been published examining cancer in animals exposed to EMFs for all or most of their lives (Moulder 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the review team concludes that the increased EMF impact on fauna posed by the operation of new 500-kV and 230-kV transmission lines proposed for the LNP project would be negligible, and additional mitigation would not be warranted.

5.3.1.3 Impacts on Important Terrestrial Species and Habitats

This section describes the potential impacts on important terrestrial species, as defined by NRC in NUREG 1555 (NRC 2000a), including Federally listed or proposed threatened and endangered species; State-listed species; and other ecologically important species and habitats resulting from operation of the proposed LNP and associated offsite facilities, including transmission lines. No designated or proposed critical habitat for Federally listed terrestrial species occurs in counties supporting the LNP site or corridors for the associated offsite facilities. Unless specifically noted, operational impacts on important terrestrial species described for the associated offsite facilities would be similar for transmission lines up to and including lines extending beyond the first substations.

Federally and State-Listed Terrestrial Species

<u>LNP Site</u>

As many as 16 Federal and/or State-listed animals at times may occur on the LNP site (Table 2-8). Based on wildlife reconnaissance surveys, life-history information, known threatened and endangered species locations, and information provided by PEF in its ER and responses to Requests for Additional Information (RAIs), only very limited use of the LNP site is expected by Federally and State-listed terrestrial species. Species known to use wetland habitats (e.g., American alligator [*Alligator mississippiensis*], wood stork [*Mycteria americana*], State-listed wading birds, and Florida black bear [*Ursus americanus floridanus*]) have been noted or are suspected to use the site occasionally. The State-listed gopher tortoise is documented for the site, and species commensal with the gopher tortoise (Florida gopher frog [*Rana capito*], Florida mouse [*Podomys floridanus*], eastern indigo snake [*Drymarchon corais couperi*], and Florida pine snake [*Pituophis melanoleucus mugitus*]) may occur there as well. Prior conversion of upland habitats to pine plantation has degraded habitat for species associated with mature forest (red-cockaded woodpecker [*Picoides borealis*]) and native xeric uplands (e.g., Florida scrub jay [*Aphelocoma coerulescens*], Sherman's fox squirrel [*Sciurus niger shermani*], and Florida burrowing owl [*Athene cunicularia floridana*]), but these species are known from the project vicinity. A condition of State certification by the FDEP (2010) would require protocol surveys for all State-listed species that may occur on the LNP site prior to land "clearing and construction". This would provide more clarity on use of the LNP site by these species.

Impacts on Federally and State-listed species from operation of the proposed LNP are expected to be relatively minor. The likelihood of avian collision with the mechanical draft cooling towers and other tall structures is expected to be minimal. Cooling-tower drift, fogging, and icing are expected to have little impact on habitats and should not affect listed species. Increased noise levels near the cooling towers, as well as increased human activity and traffic, may cause these wildlife species to avoid habitats immediately adjacent to proposed LNP Units 1 and 2. However, some level of habituation to these disturbances would likely occur. If permanent displacement of listed wildlife into adjacent habitats occurred, competition for finite resources could result in small declines in the local populations. Expected improvements to water quality and biodiversity in the upper reach of the CFBC would likely be beneficial to state listed wading birds that may forage there. Restoration and enhancement of several hundred acres of low-ecological-value pine plantations are proposed under the wetland mitigation plan for the LNP project (see Section 4.3.1.7). As explained in Section 4.3.1.7, commercial forest management would cease over parts of the site and many pine plantations and other disturbed habitats would be restored to plant communities functionally similar to native upland and wetland habitats that were present prior to logging. These actions are expected to be highly beneficial to most listed wildlife affected by the proposed LNP and could provide compensation for many potential impacts realized from operation of the LNP and associated offsite facilities. Consequently, operational impacts on Federally and State-listed species are expected to be minor.

PEF would be required to comply with all applicable laws, regulations, and permitting requirements and would use good engineering practices to minimize potential impacts on listed species. If operational impacts on state-listed wildlife cannot be avoided, the applicant would be required to coordinate with the FFWCC on the need for appropriate mitigation as stipulated under the FDEP (2010) conditions of certification. A biological assessment has been prepared by the review team to address impacts on Federally listed species that may use the LNP site. The biological assessment is provided in Appendix F. PEF would be obligated to implement any mitigation required through this process.

No Federally listed plant species are known to occur in Levy County (Table 2-8). Consequently, it is unlikely that Federally listed plants would be affected by operation of facilities on the LNP site. As many as 49 State-listed plants could possibly occur on the LNP site, based upon distribution records and habitat preferences. Florida law does not regulate the removal of State-listed plants for development or other land alterations on privately owned land. Furthermore, the LNP project would be exempt from restrictions on native flora disturbances during clearing under (8)(c) of Florida Statutes 581.185 (Hildebrandt 2010). No targeted surveys for individual State-listed plants have been conducted on the LNP site. However, extensive pedestrian surveys were conducted by biologists between September 2006 and November 2008, in conjunction with habitat mapping and wetland delineation efforts (PEF 2009g). No State-listed plants were observed during these surveys (PEF 2009a). Decades of forest management have reduced habitat suitability for State-listed plant species on the LNP site, especially those species found on native upland habitats. In the unlikely event that State-listed plants are present, drift, fogging, and icing resulting from cooling-tower operation could have an adverse but minimal impact. However, restoration and enhancement of several hundred acres of low-value pine plantations and degraded wetlands as proposed under the wetland mitigation plan for the LNP project may provide improved habitat conditions for many State-listed plants.

Listed species that use wetland habitats on the LNP site could be affected by hydrological impacts on wetlands caused by groundwater withdrawal. Although the extent of potential impacts is uncertain, monitoring to identify adverse environmental impacts caused by groundwater withdrawal is stipulated under the State-imposed conditions of certification (FDEP 2010). PEF would be required to mitigate the adverse impacts or implement an approved alternative water-supply project that would not impact wetlands (FDEP 2010).

Associated Offsite Facilities

As many as 32 Federal and/or State-listed animals at times may occur on or near the associated offsite facilities, including transmission lines (Table 2-8). Limited reconnaissance surveys (PEF 2009a, e; Golder Associates 2008) and Florida Natural Areas Inventory (FNAI) (PEF 2008a) and FFWCC (2009a) database searches of the corridors have verified the presence of listed species, such as Florida scrub jays, eastern indigo snakes, gopher tortoises, American alligators, Sherman’s fox squirrels, wood storks, and State-listed wading birds, and potentially suitable habitat was identified for other listed species. A condition of certification by the FDEP (2010) would require protocol surveys for all State-listed animals that may occur along the final rights-of-way for linear facilities before land clearing begins. These surveys would provide more clarity on use of the associated offsite facilities by Federally and State-listed species.

Federally and State-listed animals that occupy the associated offsite facilities would be subject to many of the same impacts described in Section 5.3.1.2. Periodic vegetation control along the transmission lines represents the operational activity with the most potential to affect listed species. Noise, equipment, and human presence during occasional maintenance activities would constitute an infrequent, but reoccurring, impact on these species. Highly mobile animals should be able to disperse or seek cover when disturbing activities occur. However, more sedentary animals, such the gopher tortoise and juvenile birds, could be susceptible to injury or mortality if active during mowing and other vegetation-clearing activities. Periodic mowing of the upland portions of the corridors would maintain these areas in an early successional state that should benefit species known to favor herbaceous habitats or forest edges, such as the gopher tortoise, Sherman's fox squirrel, and Florida burrowing owl. Maintenance of wetlands in an emergent and scrub-shrub state could benefit some State-listed wading birds by retaining open, shallow water habitat preferred for feeding. However, transmission-line structures, conductors, and guy wires all pose a potential collision hazard for listed birds that occupy or cross the transmission-line corridors. The Avian Protection Plan PEF is required to prepare as a condition of State certification by the FDEP (2010) would help minimize the potential for avian transmission-line mortality. Studies reviewed by NRC (1996) on the impacts of EMFs on terrestrial resources indicate the proposed 500-kV and 230-kV transmission lines should pose no adverse impact on Federally and State-listed species that use the transmission-line corridors.

Based on distribution records and habitat preferences, as many as 76 listed plant species (13 Federally listed and 76 State-listed) may occur within corridors that would support the associated offsite facilities, which include up to 180 mi of transmission lines (Table 2-8). Limited reconnaissance surveys (PEF 2009a, e; Golder Associates 2008) and PEF (2008a) and FFWCC (2009a) database searches of these corridors have documented the presence of four listed plants: pinewood dainties (P*hyllanthus leibmannianus*) *(state endangered)*, coastal mock vervain (G*landularia maritime*) *(state endangered)*, longspurred mint (*Dicerandra cornutissima*) *(federal and state endangered)*, and giant orchid (*Pteroglossaspis ecristata*) *(state threatened)*, and other listed species could be present. Initial land clearing for the final rights-of-way could affect many existing plant populations (see Section 4.3.1.3), but the low-growing non-woody vegetation created could favor establishment of other listed plant species. Any listed plant populations that persist or newly establish within the final rights-of-way could be disturbed by vegetation maintenance (previously described in Section 5.3.1.2) designed to sustain a groundcover of low-growing, non-woody species.

The collocation of more than 90 percent of the new transmission lines with existing PEF lines (PEF 2009g) would greatly minimize the extent of operational impacts resulting from the LNP project. If operational impacts on state listed species cannot be avoided, the applicant would be required to coordinate with the FFWCC on the need for appropriate mitigation under the FDEP (2010) conditions of certification. A biological assessment has been prepared by the review team to address impacts on Federally listed species that may use the associated offsite facilities. The biological assessment is presented in Appendix F. PEF would implement any mitigation recommended through this process. Additional mitigation could be required for State-listed species under the FDEP (2010) State conditions of certification. However, Florida law does not regulate the removal of State-listed plants for development or other land alterations on privately owned land. The LNP project would also be exempt from restrictions on native flora disturbances during clearing under (8)(c) of Florida Statutes 581.185 (Hildebrandt 2010). PEF (2009f) has committed to work with the regulatory agencies to prepare management plans that reduce impacts on listed species that occur within rights-of-way under company control. The restoration, enhancement, and protection of several hundred acres of degraded pine plantation are proposed under the wetland mitigation plan for the proposed LNP project (see Section 4.3.1.7). This effort would be highly beneficial to many listed species affected by the LNP project and could compensate for many of the potential impacts realized from development and operation of the LNP and associated offsite facilities.

Other Important Terrestrial Species and Habitats

LNP Site

No unique or rare habitats, or habitats with priority for protection (other than wetlands that are discussed in Section 5.3.1.1), are identified on the LNP site that could be affected by operations (PEF 2009a). Plant communities on the LNP site have been extensively modified by decades of intensive forest management. Several preserves and conservation areas are located near the LNP site – the closest being the Goethe State Forest, which lies along the northeastern boundary of the site. Any potential impacts associated with drift, fogging, and icing would not be expected to extend beyond 3280 ft from the nearest cooling tower (PEF 2009a), which would not reach the Goethe State Forest boundary. Noise modeling predicts no perceptible to very slight increases in noise from LNP operations at the site boundary (CH2M Hill 2008).

Several recreationally valuable game species are known to occupy the LNP site that could be affected by project operations (e.g., white-tailed deer, northern bobwhite, and wild turkey [*Meleagris gallopavo*]). These species and the habitats they prefer are locally abundant in the project vicinity. Drift, fogging, and icing are expected to cause little impact on habitats and would not be expected to affect important game species. Increased noise levels near the cooling towers, as well as increased human activity and traffic, may cause these wildlife species to avoid habitats immediately adjacent to proposed LNP Units 1 and 2. However, some level of habituation to these disturbances would likely occur. If permanent displacement of some game species into adjacent habitats occurred, competition for finite resources could result in small declines in the local populations. However, restoration of low-value pine plantations to native habitats as proposed under the wetland mitigation may more than compensate for any potential population declines. Consequently, operational impacts on game species are considered to be minor, and no additional mitigation would be warranted.

Impacts on bald eagles from operation of proposed LNP Units 1 and 2 are expected to be negligible. The LNP site does not provide quality aquatic foraging habitat for the bald eagle, and nesting is not documented there. Several bald eagle nests are documented between 1 and 2 mi from the LNP site. However, noise from project operation is not expected to be perceptible at these nest sites.

Associated Offsite Facilities

No unique or rare habitats, or habitats with priority for protection (other than wetlands that are discussed in Section 5.3.1.1), are identified for the associated offsite facilities corridors. However, because of the linear extent of the associated facilities, a number of wildlife sanctuaries, refuges, and preserves exist near or are crossed by the corridors (see Section 2.4.1.4). Collocating more than 90 percent of the new transmission lines with existing PEF lines would minimize the extent of new operational impacts resulting from the LNP. Nevertheless, noise, traffic, and human presence associated with occasional maintenance activities could result in minor, temporary impacts on adjacent conservation areas. Studies reviewed by NRC (1996) on the impacts of EMFs on terrestrial resources indicate that the proposed 500-kV and 230-kV transmission lines should pose no adverse effect on terrestrial flora and fauna in adjacent conservation areas (see Section 5.3.1.2).

A variety of recreationally valuable game species (e.g., white-tailed deer, eastern cottontail rabbit, various waterfowl, mourning dove [*Zenaida macroura*], northern bobwhite) are expected to occur along the associated offsite facilities corridors wherever suitable habitat is present. Noise, equipment, and human presence associated with occasional maintenance activities could result in very minor, temporary impacts on these species. Most game species are highly mobile and should disperse from the area when disturbing activities occur. However, small game (e.g., cottontail rabbits) may occasionally be killed during mowing, and the eggs and young of ground-nesting game birds (e.g., northern bobwhite) could be destroyed if mowing was conducted during the nesting season. Transmission-line structures, conductors, and guy wires would all pose a potential avian collision hazard for waterfowl and other game birds that live in or fly through these areas. A review of avian collision hazards by NRC (1996) concluded that bird mortality associated with transmission lines was generally of small significance for healthy avian populations. Nonetheless, the Avian Protection Plan PEF is required to prepare as a condition of State certification by the FDEP (2010) would reduce the potential for mortality of avian game species (see Section 5.3.1.2). Periodic vegetation management of the upland portions of the transmission-line corridors would maintain these areas in an early successional state that would benefit game species that exploit early seral communities and habitat edge. Considering these factors, these operational impacts on game species are judged to be minor, and no additional mitigation would be warranted.

Bald eagles are widely distributed throughout central Florida wherever suitable aquatic foraging habitat is present. A number of bald eagle nests (both active and inactive) exist on or near the corridors for the associated offsite facilities. If bald eagle nests are located near final rights-of-way and maintenance is conducted during the nesting season, noise, equipment, and human presence could adversely affect nesting bald eagles. If operational impacts on bald eagle nests cannot be avoided by following FWS (2007) and the FFWCC (2008) guidelines for bald eagles, PEF would need to obtain a FFWCC Eagle Permit and FWS authorization under the Bald and

Golden Eagle Protection Act of 1940 (16 USC 688a-d). Transmission-line structures, conductors, and guy wires all pose a potential avian collision hazard for bald eagles that fly through transmission-line corridors. The Avian Protection Plan PEF must prepare as a condition of State certification by the FDEP (2010) would minimize the potential for transmission-line mortality of bald eagles (see Section 5.3.1.2). Accounting for these circumstances, impacts on bald eagles from operations associated with the proposed LNP-associated offsite facilities are likely to be minor, provided that appropriate permits are acquired from the FWS and FFWCC and an Avian Protection Plan is implemented.

Transmission-line structures, conductors, and guy wires also pose a potential avian collision hazard for whooping crane that may fly across transmission lines. Substantial portions of the proposed transmission-line corridors (including both corridors up to the first substation and corridors beyond the first substation) lie within the primary range of the non-migratory Kissimmee Prairie population, the migration route for the migratory whooping crane population crosses proposed transmission-line corridors, and the CREC to Brookridge corridor would lie within 2 mi of the wintering site for the migratory population. Co-location of more than 90 percent of the proposed transmission lines with existing PEF transmission lines (PEF 2009e) would minimize new bird collision hazards. The Avian Protection Plan to be prepared by PEF as a condition of State certification (FDEP 2010) would also minimize the potential for transmission-line mortality (see Section 5.3.1.2). These measures should greatly reduce the likelihood that whooping crane would suffer injury or mortality from LNP-associated transmission lines.

5.3.1.4 Terrestrial Monitoring

PEF prepared a wetland mitigation plan (Entrix 2010) to compensate for the loss or impairment of functions of all wetlands affected by development and operation activities, including wetland impacts on the LNP site and those on the associated offsite facilities corridors (see Section 4.3.1.7). Monitoring to evaluate success of the mitigation wetlands and document permit compliance is a component of the wetland mitigation plan.

A State condition of certification by FDEP (2010) would require PEF to develop and implement an environmental monitoring plan to evaluate the relative condition of surface waters and wetlands in areas potentially affected by operational groundwater withdrawals. Monitoring would be required for a minimum of 5 years following groundwater use rising to more than 1.25 Mgd. Monitoring results are to be submitted annually to the SWFWMD for compliance review. If ongoing environmental monitoring, aquifer performance testing, or groundwater modeling predict or detect adverse environmental impacts, PEF would be required to either mitigate the adverse impacts on wetlands or implement an approved alternative water-supply project (FDEP 2010).

A condition of certification by the FDEP (2010) would also require PEF to prepare an Avian Protection Plan in coordination with the FFWCC and FWS. The plan must detail a program to reduce the operational risk to birds posed by the LNP electric utility facilities, with the goal of reducing avian mortality. An important part of this plan would include a monitoring system to document bird mortalities along transmission lines. This information would be used to identify avian problem areas and potential or known high risks.

Monitoring for Federally and State-listed species may be required to meet conditions stipulated by the FWS and the FFWCC, either associated with the Endangered Species Act of 1973, as amended, (ESA) or for State permits to take or relocate State-listed species.

5.3.1.5 Potential Mitigation Measures for Terrestrial Impacts

The wetland mitigation plan proposed by PEF (Entrix 2010), as well as the Avian Protection Plan PEF is required to prepare under the conditions of State certification by the FDEP (2010), would provide compensatory mitigation for terrestrial-related impacts resulting from the operation of the proposed LNP. The wetland mitigation plan, discussed in Section 4.3.1.7, provides a landscape-level ecosystem benefit by enhancing and restoring ecological functions to hundreds of acres of wetland habitat and supporting uplands in the watersheds affected by project wetland impacts. Mitigation for unavoidable wetland impacts is required under both the Federal Water Pollution Control Act (Clean Water Act) Section 404 permit process and the Florida Environmental Resource Permit process. This effort is expected to be beneficial to terrestrial resources and ecosystem functions in the project area, including Federally and State-listed species.

The Avian Protection Plan is intended to detail a program to reduce the operational risk to birds posed by the LNP electric utility facilities, with the goal of reducing avian mortality. If additional mitigation is identified during listed species consultations with the FWS and the FFWCC or other FDEP (2010) post-certification permit compliance requirements efforts, PEF would be obliged to implement these measures as well. PEF (2009i) also has committed to work with the regulatory agencies to prepare management plans that reduce impacts on listed species that occur within transmission-line corridors under company control.

5.3.1.6 Summary of Impacts on Terrestrial Resources

The review team evaluated the potential effects of operating the LNP project, including onsite and associated offsite facilities, on terrestrial ecological resources. Potential impacts on wildlife populations, habitats, and wetlands posed by the heat-dissipation system, tall structures, increased noise and traffic, nighttime lights, transmission lines, and rights-of-way maintenance for the associated offsite facilities are expected to be relatively localized, and mitigable. Uncertainty exists regarding the potential for wetland impacts caused by groundwater withdrawal. Hydrological monitoring to ensure that groundwater withdrawals do not adversely affect wetlands would be required under the State-imposed conditions of certification (FDEP 2010). If wellfield aquifer performance testing, revised groundwater modeling or environmental monitoring of wetlands either detects or predicts adverse wetland impacts, PEF would be required to mitigate the impacts or implement an approved alternative water-supply project (FDEP 2010).

As many as 32 listed wildlife species (9 Federally listed; 32 State-listed) and 76 listed plant species (13 Federally listed; 76 State-listed) may occur on or in the vicinity the LNP site and associated offsite facilities, including the transmission lines. To comply with Section 7 of the ESA, the review team has prepared a biological assessment that documents potential effects on Federally listed threatened or endangered terrestrial species (Appendix F). A condition of certification by the FDEP (2010) would require protocol surveys for all State-listed species (excluding plants) that may occur on the LNP site and associated offsite facilities corridors prior to land “clearing and construction”. This condition of State certification by FDEP also requires the applicant to coordinate with the FFWCC if listed species are identified during predevelopment surveys or listed species are encountered during development to determine the need for appropriate mitigation (FDEP 2010). Provided that adequate surveys are conducted prior to commencement of development, consultation with the FWS and FFWCC is initiated as needed, and appropriate mitigation is implemented, impacts on listed species would likely to be minimized. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater.

Based on the review team’s independent evaluation of the LNP project, including the ER, the Site Certification Application, PEF’s responses to the review team’s RAIs, interactions with State and Federal agencies, the public scoping process, and the identified mitigation measures and BMPs, the review team concludes that operational impacts on terrestrial ecological resources (including wetlands and listed species) would be SMALL to MODERATE. A range is provided to account for the uncertainty that exists regarding the potential effects of groundwater withdrawal on wetlands and associated biota. Additional mitigation beyond that proposed by PEF is not warranted, however, as stated in the FDEP (2010) conditions of certification, PEF must monitor groundwater and, if substantial operational hydrological effects on wetlands are discovered, PEF must either mitigate or utilize an alternative water source.

5.3.2 Aquatic Impacts Related to Operation

This section discusses the potential impacts of the operation of proposed LNP Units 1 and 2 on the aquatic ecosystem in the LNP onsite ponds, CFBC, OWR, CREC offshore discharge area in the Gulf of Mexico, and Outstanding Florida Waters and creeks crossed by the transmission-line corridors.

5.3.2.1 Aquatic Resources – Cooling-Water Withdrawal Impacts

For aquatic resources, the primary concerns related to water withdrawal are the impacts related to the potential for organisms to be impinged on the intake screens or entrained into the cooling-water system. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the CWIS (66 FR 65256). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (66 FR 65256). Entrainment occurs when organisms are drawn through the CWIS intake screens into the proposed LNP Units 1 and 2 cooling system. Organisms that become entrained are normally relatively small benthic, planktonic, and nektonic (limited movement in the water column) forms, including early life stages of fish and shellfish, which often serve as prey for larger organisms (66 FR 65256). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, thermal, and toxic stresses.

A number of factors, such as the type of cooling system, the design and location of the intake structure, and the amount of water withdrawn from the source waterbody, greatly influence the degree to which impingement and entrainment affect the aquatic biota.

PEF stated in its ER that a closed-cycle, mechanical draft cooling system would be used for proposed LNP Units 1 and 2. Closed-cycle recirculating cooling-water systems can, depending on the quality of the makeup water, reduce water use by 96 to 98 percent of the amount that the facility would use if it used a once-through cooling system (66 FR 65256). This significant reduction in water-withdrawal rate results in very significant reductions in impingement and entrainment.

The EPA indicated (66 FR 65256) that the optimal design requirement for the intake location is to place the inlet of the CWIS in an area of the source waterbody where impingement and entrainment of organisms are minimized by locating intakes away from areas that have the potential for high productivity. Biological surveys in the area of the proposed CWIS intake indicate a biologically depauperate community dominated by sedimentary worms and a few euryhaline fish (see Section 2.4.2). However, once the CWIS is operational, the environment near the intake would increase in salinity concentration and dissolved oxygen, resulting in an overall improvement in water quality that may attract individuals and species.

Species surveyed in the OWR where it joins with the CFBC are similar to species found between sampling stations 1 and 2 within the CFBC. The predicted increase in salinity concentrations in the lower portion of the OWR is still within the salinity-tolerance range of the species sampled at this location. The zone of transition between brackish and freshwater habitats moves farther up the OWR depending on discharge events originating from the Inglis Dam on Lake Rousseau, but a freshwater zone remains at the origin of the OWR (CH2M Hill 2009b).

The CFBC near the proposed intake essentially is a dead-end with tidal exchange being the only appreciable flow along with leakage through the lock. As discussed in Section 5.2.3.1, the increment in velocity within the CFBC due to the operation of the LNP intake would be less than one-sixth of the average velocity of the incoming tidal waters during low-flow conditions. The velocity of up-canal water movement associated with the intake flow would be less than 0.06 fps under low-flow conditions.

Another factor, the intake design through-screen velocity, greatly influences the rate of impingement of fish and shellfish at a facility. Generally, for a fixed withdrawal rate, the higher the through-screen velocity, the greater the number of fish impinged. The EPA has established a national standard for the maximum design through-screen velocity of no more than 0.5 fps (66 FR 65256). The EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 fps, and then applied a safety factor of 2 to derive the threshold of 0.5 fps. PEF has stated that the proposed LNP Units 1 and 2 intake structure would have a design through-screen velocity below 0.5 fps (PEF 2009a).

Entrainment losses due to operation for a closed-cycle plant are a function of the volume of water withdrawn and are independent of through-screen velocity rate because entrained organisms (i.e., eggs, plankton) are incapable of avoiding being drawn into the intake structure.

Impingement and entrainment studies have been conducted for the existing CREC. The studies were performed in 1983 and 1984 to examine impingement and entrainment for three intakes providing cooling water for fossil-fuel Units 1 and 2 and nuclear Unit 3, post operation (Stone & Webster 1985). Although the operation of these three units has more than 13 times higher withdrawal rates (1897 to 1613 Mgd) and twice the through-screen velocity (1.0 fps) than those proposed for the LNP units, the impingement and entrainment studies provide contextual information about the impact on relevant species that are present in the Gulf of Mexico and may be affected by LNP operations. In support of the Clean Water Act Section 316(b) Track I requirements, PEF conducted a 316(b) demonstration study to incorporate these requirements into an NPDES permit for LNP Units 1 and 2 (PEF 2008a).

Impingement and entrainment studies were conducted to assess impacts as required under NPDES Permit FL0000159 for CREC (Stone & Webster 1985). Sampling for impingement rates occurred four times over a 24-hour period every 2 weeks for 1 year by examination of collection baskets attached to screen-wash effluents. The three units were assessed by individual intake, but the results are combined for discussion purposes here. The highest abundances of organisms were collected in the spring, with bay anchovy (*Anchoa mitchilli*) collected in the greatest numbers with estimates of more than 87,000 impinged annually. Polka-dot batfish (*Ogcocephalus cubifrons*) and spot (*Leiostomus xanthurus*) were two other species also collected in significant numbers. Together, the three species represented more than 72 percent of the selected indicator fish impinged. In 1997, the State of Florida set an annual commercial harvest limit of 85,000 lb of bay anchovy for the counties of Wakulla, Franklin, Gulf, Bay, Okaloosa, and Walton (Fla. Amdin. Code 68B-50.002), but bay anchovy are not regulated for commercial harvest in Citrus or Levy Counties (FFWCC 2009b). Eighty-seven thousand organisms represents approximately 350 lb (average 0.004 lb per fish), indicating that the loss of 350 lb of bay anchovy due to plant operation compared to the commercial harvest limit listed above represents a fraction of this abundant species. The numbers of invertebrates impinged were much higher than for fish, with pink shrimp (*Farfantepenaeus duorarum*) and blue crab (*Callinectes sapidus*), the predominant species. Like fish, invertebrate impingement was highest in the spring. More than 640,000 pink shrimp and 383,000 blue crab were impinged over a year. These impingement numbers represent 0.6 percent and 0.7 percent of the annual commercial fishery for Citrus County in 1982, respectively (Stone & Webster 1985) and reflect impingement rates for a through-screen velocity of 1.0 fps and a combined intake flow rate of 1897 to 1613 Mgd. By comparison, the potential impingement impacts of proposed LNP Units 1 and 2 should be notably less with a through-screen velocity of less than 0.5 fps and a combined intake flow rate of 122 Mgd.

Entrainment of marine species is limited to what will pass through the 3.5-in. opening between the bar racks and through the 3/8-in.-mesh intake screens. Because the life stages of threatened and endangered species described in this biological assessment are larger than the openings in the intake screen mesh, these species are not likely to be entrained into the LNP cooling-water system. However, food sources for the threatened and endangered species may pass through the intake screens as eggs or larvae and are discussed in terms of relative abundance. Plankton samples were collected for the CREC 316 studies (1985) from 15 sampling stations offshore in the vicinity of the CREC intake canal every 2 weeks for 15 months using 505-μm mesh with a 1-m mouth towed for 3 minutes from bottom to the surface at a constant flow rate. These samples were analyzed for estimation of entrainment of eggs and larvae for CREC intakes 1–3. April and May were peak collection times for eggs, while invertebrate meroplankton were collected in the highest numbers in July and August. Bay anchovy eggs, larvae, and juveniles were the most abundant, and using foregone production assumptions regarding life history and survival, represent approximately 21.7 million adults (Boreman et al. 1981). Recreationally important fish entrained included larvae and/or juveniles of silver perch (*Bairdiella chrysoura*; 6602 adult equivalents as assessed for growth and mortality factors (CH2M Hill 2009c), spotted seatrout (*Cynoscion nebulosus*; 900 adult equivalents), red drum (*Sciaenops ocellatus*; 18 adult equivalents), spot (690,000 adult equivalents), and striped mullet (*Mugli cephalus*; 5985 adult equivalents). With the exception of spot, the entrainment impact on these fish represents less than 0.2 percent of the estimated annual commercial harvest for each species. The 1982 commercial harvest of spot for Citrus and Levy Counties was equivalent to the estimated numbers (based on weight) of entrained spot (Stone & Webster 1985).

Invertebrate sampling indicated that shrimp, stone crab (*Menippe mercenaria*), and brief squid (*Lolliguncula brevis*) could be entrained. Although no pink shrimp were collected, other shrimp post larvae and juveniles were assessed without distinguishing species and represent greater than 29,000 adult equivalents. Florida stone crab zoeal through megalops stages and brief squid were collected and estimated to represent 3652 and 3600 (194 lb) adult equivalents for a year, respectively. With commercial harvest of shrimp of more than 1 million lb, the number of shrimp lost to entrainment is minimal. Likewise, the number of entrained brief squid is small with commercial landings of squid in Pasco and Pinellas Counties in 1986 exceeding 2900 lb (FFWCC 1986). The impact on entrained stone crabs is difficult to assess because the commercial fishery is renewable and only the claws are harvested. However, more than 950,000 lb of claws were harvested in Citrus and Levy Counties in 1982, and, assuming that claws make up half the weight (Lindberg and Marshall 1984), the loss of commercial harvest due to entrainment would be less than 0.01 percent. By comparison, the CREC withdrawal of water from the Gulf of Mexico is between 1897 and 1613 Mgd, which is more than 13 times greater than the proposed water withdrawal of 122 Mgd from the CFBC for proposed LNP Units 1 and 2. Entrainment impacts for LNP are expected to be significantly less than for CREC and, when compared to estimated adult equivalent impacts for CREC, range from less than 0.4 percent of total adult equivalents for spotted seatrout (3 adult equivalents for LNP) and less than 23 percent of total adult equivalents for red drum (4 adult equivalents for LNP) based on sampling done in the CFBC as described in Section 2.4.2.1 (CH2M Hill 2009c).

For the LNP Units 1 and 2 CWIS, PEF estimated potential impingement and entrainment impacts for withdrawal of cooling water from the CFBC based on design and construction technology, baseline biological characterization, and zone of hydraulic influence. The zone of hydraulic influence is the region of the CFBC in which a nonmotile organism in the waterbody will be drawn into the intake. PEF estimated that the zone of hydraulic influence would extend 5 mi west from the CWIS in the CFBC (PEF 2008c) and used an offshore station in the Gulf of Mexico to estimate impingement and entrainment impacts. Sampling in the area of the proposed CWIS indicated a biologically depauperate environment with relatively poor water quality (PEF 2009a). As described in Section 5.2.3, the CFBC currently has elevated salinity from incoming tidal exchange that would increase only slightly with operation of intakes for LNP Units 1 and 2. Using conservative assumptions that the water quality may approach attributes similar to those observed in the CFBC near sampling station 3 at the mouth, PEF estimates that the number and diversity of species are likely to increase near the CWIS for the life stages of organisms that are mobile and actively feeding. However, the portions of the CFBC sampled near stations 3 and 4 are not known spawning areas, and plankton likely drift in and out of this area under tidal influence. Therefore, the potential for entrainment of aquatic organisms during operation of the CWIS would likely increase as a result of the changes induced by operation of the CWIS and not due to colonization or use of habitat near the CWIS. However, the overall impingement and entrainment of aquatic organisms for LNP is still expected to be minimal for aquatic populations in the CFBC and the Gulf of Mexico.

Maintenance of the CWIS includes the use of screen washes and mechanical scraping to prevent clogging or collection of debris and organisms on intake screens and bar racks, respectively. Bar racks would be removed and scraped once per quarter as currently done at CREC (PEF 2009e). Trash and organisms caught on traveling intake screens would be removed by a high-pressure spray wash and deposited into a collection dumpster. Collected debris and organisms would be disposed of in a licensed landfill.

Based on the planned low through-screen intake velocity, the use of closed-cycle cooling, the distance of the intake canal from the Gulf of Mexico, the lack of spawning habitat within the CFBC, and the comparison of impingement rates for existing CREC Units 1–3, the staff concludes that impacts from impingement of aquatic organisms for proposed LNP Units 1 and 2 would be minor.

Based on the percentage of water withdrawn, the closed-cycle cooling-system design, the distance away from preferred spawning habitat in the Gulf of Mexico, and the comparison of entrainment rates for the existing CREC Units 1–3, the staff finds that the impacts on the aquatic organism eggs and zooplankton of the Gulf of Mexico from entrainment due to operation of LNP 1 and 2 would be minor.

Cooling-Water Discharge Impacts

The potential impacts on the Gulf of Mexico from the operation of proposed LNP Units 1 and 2 would include the impacts of heated effluents on aquatic resources, chemical impacts, and physical impacts from discharge.

Aquatic Thermal Impacts

The effluents from proposed LNP Units 1 and 2 would be discharged directly into the CREC discharge. Section 4.3.2 of this EIS discusses the location and design of the discharge piping. The proposed LNP Units 1 and 2 discharge would be 4.4 percent of the total discharge from combining LNP and CREC Units 1 through 5 discharges. The potential incremental impacts on the Gulf of Mexico from the operation of proposed LNP Units 1 and 2 would include the impacts of heated effluents on aquatic resources, chemical impacts, and physical impacts from discharge.

<u>Cold Shock</u>

A factor related to thermal discharges that may affect aquatic biota is cold shock. Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant’s discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter. Cold shock mortalities at U.S. nuclear power plants are “relatively rare” and typically involve small numbers of fish (NRC 1996). It is less likely to occur at a multiple-unit plant because the temperature decrease from shutting down one unit is moderated by the heated discharge from the units that continue to operate. The NRC staff is unaware of any outage that has resulted in cold shock stress at CREC. The discharge from proposed LNP Units 1 and 2 would be 4.4 percent of the total discharge from combining LNP and CREC discharges. Based on the foregoing, the staff concludes the thermal impacts on the fish populations due to cold shock would be minor, and additional mitigation would not be warranted.

Heat Stress

The thermal tolerance for aquatic organisms is defined in different ways. Some definitions relate to the temperature that causes fish to avoid the thermal plume. Other definitions relate to the temperature that fish prefer for spawning, and still others relate to the temperatures (upper and lower) that may kill individual fishes. Some of these tolerances are termed “preferred temperatures,” “upper avoidance temperatures,” and “lethal temperatures.”

In Section 5.2.3.1, the staff describes its independent assessment of the incremental impacts of proposed LNP Units 1 and 2 on the water temperatures within the CREC discharge and the Gulf of Mexico using a three-dimensional coastal ocean model. The staff is also aware of the proposed uprate of CREC Unit 3 and the possibility that CREC Units 1 and 2 (fossil-fuel plants), which contribute approximately two thirds of the discharge flow, would be decommissioned once LNP Units 1 and 2 begin operation. A thermal analysis discussing both scenarios is presented in Sections 7.2.2.1 and 7.3.2 describing potential future actions that may affect any LNP discharge impacts. During summer conditions at ebb tide, the surface-water temperatures near the CREC discharge channel would be slightly less with operation of LNP 1 and 2 when compared with current conditions that include operation of CREC Units 1–5. The discharge volume of the plume would be increased with the addition of LNP Units 1 and 2, but only a slight increase in surface-water temperature (<0.1°C) would result compared with current conditions. Temperature increase at the entrance of the CFBC channel would be between 0.05°C and ~0.1°C during the summer months at ebb tide (Figure 5-6). Similar trends in thermal plume temperatures would be observed during winter conditions with the addition of LNP discharge resulting in a slight temperature drop at the CREC discharge canal, and a slight increase in surface-water temperature beyond the immediate discharge area. Surface-water temperatures at the mouth of the CFBC are expected in increase by less than 0.5°C over the current conditions (Figure 5-7). The increased plume size would likely have minimal impact on aquatic biota that forage near the CFBC under both extreme conditions. Habitat usage is not expected to be affected under proposed conditions.

Based on the foregoing, the staff concludes that the thermal impacts on habitat and aquatic biota of the discharge of waste heat from LNP Units 1 and 2 into the CREC discharge canal and Gulf of Mexico would be minor, and additional mitigation would not be warranted.

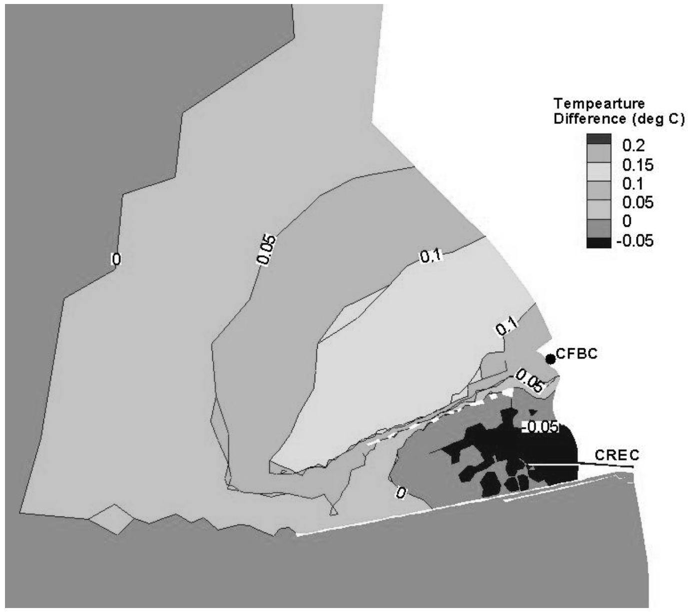

Figure 5-6. Thermal Plume Analysis Using the Finite Volume Community Ocean Model (FVCOM) Showing the Temperature Difference Between the Current and Proposed Thermal Discharge Under Summer Conditions at Ebb Tide

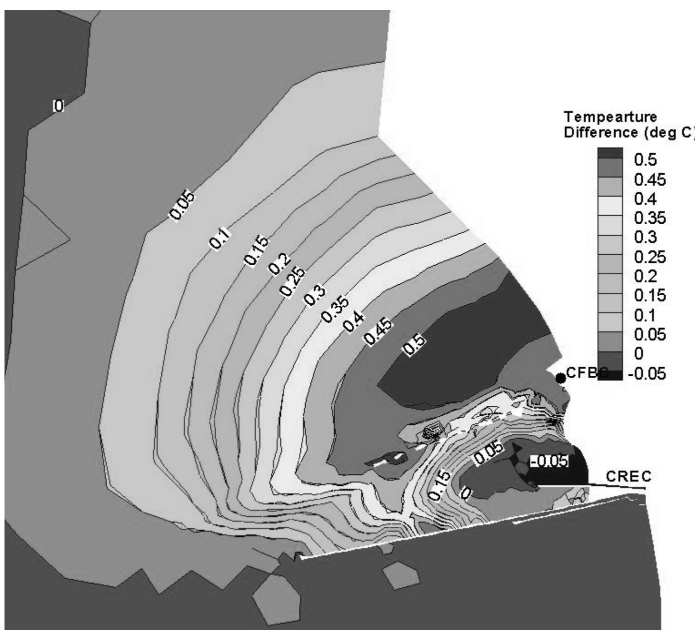

Figure 5-7. Thermal Plume Analysis Using the FVCOM Showing the Temperature Difference Between Current and Proposed Thermal Discharge Under Winter Conditions at Ebb Tide

<u>Invasive Nuisance Organisms</u>

Invasive nuisance organisms found in the CFBC include the false dark mussel (*Mytilopsis leucophaeata*), barnacles (*Chthamalus fragilis*), and the green porcelain crab (*Petrolisthes armatus*). None of these invasive species, or any other invasive species, has been observed to have increased in numbers as a result of the thermal plume operated by CREC Units 1–5. Therefore, no large growth of invasive nuisance organisms is anticipated from the thermal plume for proposed LNP Units 1 and 2, because the overall thermal change would be less than 1°C during summer and winter conditions.

Chemical Impacts

Other discharge-related impacts include the chemical treatment of the cooling water. The ER indicates that chemicals would be added to the circulating-, service-, and blowdown-water systems (PEF 2009a). Intake structures, such as the pump suction housings and sensor tubes, would be coated with a copper-based, anti-fouling substance to minimize fouling of these structures. In addition, ClamTrol (CT1300) would be injected every 21 days at a concentration not to exceed 4.5 ml/L into cooling-water intake structures to prevent biofouling of marine invertebrates (PEF 2009e). The use of chemicals in the existing CREC discharge is regulated by an NPDES permit, which is granted by the FDEP. The chemical concentrations at the outfall for the existing units meet the NPDES limits (FDEP 2008).

Table 5-3 lists the water-treatment chemicals, their uses, and the concentrations that are anticipated to be discharged from proposed LNP Units 1 and 2 blowdown. The CREC effluent discharge and water flow from the Gulf of Mexico would further dilute the concentration of these chemicals.

In addition, the NRC staff evaluated the potential for impact due to the increased salinity associated with the LNP Units 1 and 2 blowdown, which is estimated to have a TDS concentration of 1.5 times greater than seawater (PEF 2009e). This increase in TDS is due to evaporative loss of water through the cooling towers. Because the LNP discharge would be combined with CREC discharge prior to point of discharge into Crystal Bay and the CREC discharge accounts for the vast majority of the discharge volume (>95 percent), the increase in salinity would be slight (0~0.5 ppt) in the coastal region near the CREC discharge channel, and between 0.4 ppt~0.45 ppt at the mouth of the CFBC (Figure 5-8). Thus, the impacts from the addition of LNP discharge to the Gulf of Mexico would be minimal. As described in Section 5.7.2, salt deposition from cooling-tower drift is predicted to be a maximum of 10.75 kg/ha/mo onsite. Deposition of salt decreases rapidly with increasing distance from cooling towers, and is therefore not expected to detectably affect the closest freshwater bodies, which are approximately 3 mi to the south (Lake Rousseau and the Lower Withlacoochee River) from the LNP site.

Table 5-3. Chemical Discharges to the Gulf of Mexico from Proposed LNP Units 1 and 2

Chemical	Use	Dosage Concentration	Expected Concentration at Discharge Point
Sodium hypochlorite	Biocide	0.2 ppm residual chlorine or 0.36 sodium hypochlorite	<0.01 ppm
Ammonium chloride	Algaecide	0.2 ppm residual chlorine or 0.303 ppm ammonium chloride	<0.01 ppm
Sulfuric acid	pH adjuster	2.237 ppm sulfuric acid	pH in range
Orthopolyphosphate	Corrosion inhibitor	30 ppm orthopolyphosphate	Small amounts of total phosphorus
Polyacrylate	Silt dispersant	150 ppm polyacrylate	Inert solids <10 microns
Phosphonate	Antiscalant	20 ppm phosphonate	Negligible due to infrequent use and small discharge volume

Sources: PEF 2008a , 2009a

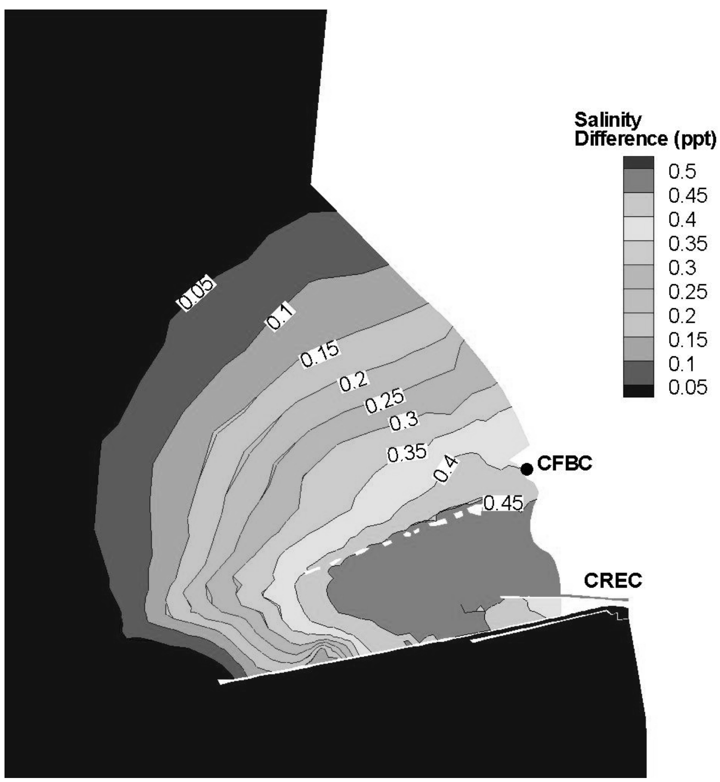

Figure 5-8. Salinity Difference Between the Current (CREC Units 1–5) and Proposed (CREC Units 1–5 and LNP Units 1 and 2) Discharge Plume at Ebb Tide

Physical Impacts from Discharge

The discharge volume of the LNP Units 1 and 2 blowdown would be 81.34 Mgd and would be combined with the CREC Units 1–5 discharge of 1651.8 Mgd in the CREC discharge canal, which opens into the Gulf of Mexico. The LNP discharge would contribute only 4.4 percent of the total discharge flow and would have little effect on physical scouring at the terminus of the discharge canal (PEF 2009a).

Based on this analysis of the potential for physical impacts on the aquatic ecosystem from the discharge of cooling water to the Gulf of Mexico and the staff's independent review, the staff concludes that the physical impacts from thermal discharges from proposed LNP Units 1 and 2 would be minor because the incremental increase in the discharge flow is less than 5 percent and any impact due to the small increase in scouring would be undetectable outside of the short distance from the discharge terminus.

Stormwater Drainage

A few permanent and temporal shallow pools currently exist on the LNP site. Operation of Levy Units 1 and 2 would not result in any surface-water discharge to these waterbodies. Stormwater infiltration ponds would be constructed to manage runoff onsite during operations (PEF 2009a). Only in the unlikely overtopping of the infiltration ponds during a severe rainfall event would these onsite waterbodies receive any surface runoff from the infiltration ponds. There is no connection of these onsite pools or proposed stormwater infiltration ponds to the CFBC, Withlacoochee River, or the Gulf of Mexico. The staff concludes that based on the use of a stormwater system described in the stormwater-management plan, the impacts on onsite aquatic resources, the CFBC, Withlacoochee River, and the Gulf of Mexico from operation of the proposed LNP Units 1 and 2 would be minor.

Maintenance Dredging

The NRC staff evaluated the likelihood of maintenance dredging in front of the barge-unloading facility and CWIS. A barge slip/boat ramp and dock would be constructed along the northern shore of the CFBC just upstream of the proposed CWIS and 0.5 mi downstream from the Inglis Lock. Maintenance dredging for the barge-unloading facility and the CWIS within the CFBC is not proposed because the depth of the CFBC has not changed since its construction in the 1960s, and increased sediment load is not predicted under operation conditions (CH2M Hill 2009d). The upland portion of the barge slip/boat ramp is expected to be available to members of the public.

Groundwater Use Impacts on Aquatic Resources

Based groundwater modeling, there may be a reduction of 0.4 Mgd of the groundwater discharge to the Lower Withlacoochee River and Lake Rousseau as a result of service-water pumping from groundwater wells for proposed LNP Units 1 and 2. As discussed in Section 5.2.2.2, the reduction is expected to have minimal impact on the estimated total groundwater discharge of 687 Mgd to the Lower Withlacoochee River/Lake Rousseau watersheds and thus would have minimal impact on the ecology of these waterbodies.

5.3.2.2 Aquatic Resources – Transmission Lines

Maintenance activities along the four 500-kV, five 230-kV, and two 69-kV transmission lines could lead to periodic temporary impacts on the waterways being crossed. However, it is assumed that the same vegetation-management practices currently used by PEF for the existing CREC facility transmission-line corridors would be applied to the existing and proposed new transmission-line corridors. PEF practices and procedures were developed to prevent impacts on surface waters and wetlands, so impacts on aquatic ecosystems from operation and maintenance of transmission lines would be small (PEF 2009a). PEF plans to leave a 25-ft buffer of existing vegetation with mature heights not exceeding 12 ft at locations where the transmission-line corridor crosses a navigable waterway, including limited use of herbicides near these buffer zones (PEF 2008a). Maintenance of vegetation in transmission-line corridors will be performed in accordance with PEF's Transmission Vegetation Management Program (PEF 2008a). Impacts on aquatic species are not anticipated from maintenance of the transmission lines. Therefore, impacts would be considered small, and additional mitigation would not be warranted.

The staff concludes that the impacts of transmission-line corridor maintenance activities on aquatic resources would not adversely impact aquatic ecosystems, and additional mitigation beyond that already described would not be warranted.

5.3.2.3 Aquatic Species and Habitats

Important Species

This section describes the potential impacts on important aquatic species (see Table 2-14) resulting from operation of the new units at the proposed LNP site, cooling-water intake and discharge, and maintenance of transmission-line corridors. The staff has determined that operational aquatic impacts would be limited to the CFBC and the point of discharge from the CREC discharge canal, which includes the nearshore Crystal Bay area of the Gulf of Mexico. The general life histories of these species are presented in Section 2.4.2. The staff prepared biological assessments documenting the impacts of operation of a new nuclear unit on the Federally listed threatened and endangered aquatic species described in the FWS and National

Marine Fisheries Service (NMFS) correspondence (FWS 2009; NOAA 2008a, b). The staff also prepared an essential fish habitat assessment submitted to NMFS. The staff's impact determinations from the biological assessments and essential fish habitat assessment are reiterated in this section.

Commercial Fishery

With the exception of the blue crab, all commercial fishery activities occur well offshore from the CFBC and CREC point of discharge into the Gulf of Mexico. Commercial blue crab pots were observed within the lower portion of the CFBC on two separate occasions, but they were not evident near the location of the proposed CWIS. Operation of the CWIS and discharge are not expected to affect commercial fisheries in the Gulf of Mexico within the CFBC because these species are able to escape from an intake velocity of less than 0.5 fps, they spawn offshore, and no significant changes are expected in the commercial fisheries due to changes in the CREC discharge with the addition of LNP effluent.

Recreational Fishery

Recreational angling occurs within the CFBC, but it is limited to the CREC outside of the discharge canal at the point of discharge. Operation of the CWIS, discharge, and corridor maintenance are not expected to affect recreational fisheries in the Gulf of Mexico, within the CFBC, or within waterbodies spanned by transmission lines because these species are able to escape from an intake through-screen velocity of less than 0.5 fps, they spawn offshore, and would be unaffected by the insignificant changes expected in the Gulf due to changes in the CREC discharge with the addition of LNP effluent.

Essential Species

The presence of abundant forage fish, such as silver perch and spotfin mojarra (*Eucinostomus argenteus*), within the CFBC and offshore of the CREC discharge are summarized in Table 2-14. Operation of the CWIS, discharge, and corridor maintenance are not expected to affect the presence or habitat use of these forage species in the vicinity of these activities because these species are able escape away from an intake through-screen velocity of less than 0.5 fps, they spawn offshore, and no significant changes are expected in the Gulf due to changes in the CREC discharge with the addition of LNP effluent.

Rare Species

Speckled hind (*Epinephelus drummondhayi*) and Warsaw grouper (*Epinephelus nigritus*), both listed as species of concern by the NMFS, are known to occur in the inland waters of the Florida Gulf Coast. However, neither of these species was collected during 2 years of sampling within the CFBC, so any CWIS operational impacts on these species would be unlikely. Addition of

LNP effluent within the CREC discharge would not significantly alter the discharge in the CREC offshore area. No significant changes are expected in these species due to changes in the CREC discharge with the addition of LNP effluent.

Federally and State-Listed Species

The Florida manatee, loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricata*), and smalltooth sawfish (*Pristis pectinata*) are Federally listed threatened and endangered species known to occur in the vicinity of the proposed LNP site and the CREC site. The endangered leatherback sea turtle (*Dermochelys coriacea*) and threatened gulf sturgeon (*Acipenser oxyrinchus desotoi*) have not been reported in these areas. Appendix F provides a detailed discussion of the potential operational impacts on Federally threatened and endangered species, which are summarized here. The sea turtles and smalltooth sawfish do not nest or reproduce in the vicinity of the proposed LNP or CREC discharge. Therefore, the impact of intake or discharge operations on newly hatched turtles or juvenile sawfish would be insignificant. Because the flow requirements under 316(b) require through-screen velocities of 0.5 feet/sec or less, any juvenile, subadult, and adult healthy sea turtles, sawfish, or manatees that enter the CFBC would be able to swim away from the zone of influence or the intake area itself during operation. However, injured or moribund species may become entrapped on the intake trash bars or traveling screens. Addition of LNP effluent within the CREC discharge would not significantly affect Federally or State-listed species due to changes in the CREC discharge. Therefore, operation of LNP may affect, but is not likely to adversely affect, juvenile, subadult, and adult sea turtles, sawfish, or manatees.

Based on this review, the staff concludes that the impacts on aquatic Federally listed threatened and endangered species from operation of proposed LNP Units 1 and 2 would be minimal, and mitigation would not be warranted.

Essential Fish Habitats

There are no areas designated as critical habitat for threatened and endangered species in the vicinity of the LNP and CREC sites, but essential fish habitat is present for both the CFBC and offshore Gulf of Mexico area of the CREC discharge. Both the CFBC and CREC discharge canal are considered essential fish habitat within Ecoregion 2. No habitats of particular concern occur in either waterbody or associated nearshore areas. Table 2-14 lists the species and life stages included under essential fish habitat for the CFBC and CREC discharge canal. Appendix F contains a detailed discussion of potential LNP impacts on essential fish habitat. The known distributions and records of Ecoregion 2 listed species and life stages, the potential ecological impacts of the construction on the species, their habitats, and their prey have been considered. Based upon the project operation plans and the use of closed-cycle cooling, the staff believes that adverse impacts on essential fish habitat would be minimal.

5.3.2.4 Aquatic Monitoring During Operation

PEF plans to perform formal monitoring of CFBC and CREC offshore Gulf of Mexico aquatic ecosystems during operations. Preoperation and operation monitoring are planned for the CFBC in the vicinity of the CWIS, the CREC discharge canal, and offshore areas to establish a preoperational baseline and to assess the impacts of operation (PEF 2009a). Impingement and entrainment studies are proposed for 1 year following full operation of proposed LNP Units 1 and 2 (PEF 2009a). As part of the State of Florida’s Conditions of Certification, “[p]re-operational survey and post-operational monitoring shall be conducted for a period of time to be determined by statistical analysis in coordination between the FWC, in consultation with DEP, and the Licensee, utilizing the same pre-operational survey methodologies in order to identify and characterize biological and water quality impacts associated with the project for any needed mitigation purposes” (FDEP 2009b). PEF will submit a Cross Florida Barge Canal and Withlacoochee River Survey and Monitoring Plan to the State for approval prior to initiation of formal monitoring. LNP and CREC combined discharge monitoring is also specified in the State of Florida’s Conditions of Certification as requiring “[a] broad-based, pre-operational survey and a postoperational monitoring plan, for a period of time to be determined by statistical analysis in coordination between the DEP, FWC and the Licensee, that is available prior to operation of the facility, that includes sites outside of the existing or predicted plume areas to allow for a comparison of the plume area sites to a "control site"” (FDEP 2009b). PEF will submit a Levy Nuclear and Crystal River Energy Complex Combined Discharge Survey and Monitoring Plan to the State for approval prior to initiation of formal monitoring.

5.3.2.5 Summary of Operational Impacts on Aquatic Resources

The staff has reviewed the proposed operational activities for proposed LNP Units 1 and 2 and the potential impacts on aquatic biota in the CFBC, OWR, Gulf of Mexico, and rivers and perennial/seasonal streams crossed by transmission-line corridors. Based on this review, the staff has determined that the impacts resulting from the proposed operational activities would be SMALL, and any mitigation beyond what is already described above would not be warranted.

5.4 Socioeconomic Impacts

Plant operations can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of operations-related activities and operations workforce on the 50 mile radius surrounding the plant (the region). The review team reviewed the ER prepared by PEF and verified the data sources used in its preparation by examining cited references and independently confirming data in discussions with community members and public officials (NRC 2009). The review team requested clarifications and additional information from PEF as needed to verify data in the ER. Unless otherwise specified in the following sections, the review team has drawn upon verified data from PEF

(PEF 2009a, c, e, i, j). Where the review team used different analytical methods or additional information for its own analysis, the sections include explanatory discussions and citations for additional sources.

PEF estimates the operations workforce for LNP Units 1 and 2 to be 773 workers (specific assumptions are discussed in ensuing sections). The operation of LNP Units 1 and 2 would increase the workforce during scheduled outages by an additional 800 workers for about 25 to 30 days every 9 months (18 months between outages for each unit). To the extent practicable, outages would be staggered.

Although the review team considered the entire region around the LNP site when assessing socioeconomic impacts, based on commuter patterns, the distribution of residential communities in the area, and the nature of the likely socioeconomic impacts of operations, the review team found the three counties that surround the site – Levy, Citrus, and Marion – to be a primary Economic Impact Area (EIA) for community impacts.

5.4.1 Physical Impacts

Potential physical impacts include noise, odors, exhausts, visual intrusions, and thermal emissions. Thermal emissions are addressed in Sections 5.2.3 and 5.3.2. The review team believes the physical impacts would be mitigated through site design and operation of the facility in accordance with all applicable Federal, State, and local environmental regulations and, therefore, would not significantly affect the EIA. The following sections assess the potential operations-related physical impacts of the proposed LNP on specific segments of the population, workers, and nearby communities.

For more than a century, the proposed LNP site has been used for forest plantations. The closest residential properties are located 1.6 mi northwest and 1.7 mi west-southwest of the proposed site. There are no sensitive populations near the proposed LNP site. The nearest recreational resources are Goethe State Forest, the Marjorie Harris Carr Cross Florida Greenway, Inglis Island Trail, Inglis Lock Recreation Area, and the CFBC (see Figure 2-23 and Figure 2-24). These recreational resources are located south and northeast of the proposed LNP site. The operations workforce for the two units would be 773 people, with less than the total being onsite at one time because of shift work.

5.4.1.1 Workers and the Local Public

This section discusses potential effects of air emissions and noise on workers, nearby residents, and nearby users of recreational areas.

Air emissions would be generated from the two mechanical draft cooling towers, the emergency power equipment (diesel generators and fire pumps), and vehicle traffic from plant operations.

The primary emitter would be the cooling towers, emitting water vapor and particulate matter. Visual effects of the water vapor plumes are discussed under “Aesthetics” (Section 5.4.1.4). The particulate matter in the cooling-tower emissions would be made up of naturally occurring salt particles dissolved and suspended in the cooling water that would be carried in water drops released to the air from the towers. As presented in Section 5.7.2, the review team reviewed modeling results that found deposition of the salt decreases rapidly with distance from the plant, at a maximum offsite deposition of 6.81 kg/ha/mo at a location west of the cooling towers.

Certificates to operate the diesel generators and fire pumps require that air emissions comply with all applicable regulations. As indicated in Section 5.7.1, because these systems would be used on an infrequent basis, the review team concludes that the environmental impacts would be minimal. A small increase in local air emissions would be expected from the vehicles of the 773 plant operations employees who would travel over the local road network. However, this increase is not expected to result in a significant change in total vehicle miles traveled in the region or a regulatory change in air quality attainment for the region or the state. The entire State of Florida is considered in attainment for the National Ambient Air Quality Standards (NAAQSs) (EPA 2010a).

Neither the cooling-tower emissions of particulate matter, operation of the emergency equipment, nor increased vehicle traffic would cause NAAQS pollutants to be emitted in quantities that exceed Federal thresholds or create or contribute to a regional haze problem. Therefore, their impact on air quality is not considered significant. Because of the limited emission of air pollutants expected during operation of the proposed LNP, the review team determined that the LNP’s effect on air quality would be minor.

Operation of the proposed LNP would produce noise from the operation of pumps, transformers, turbines, and generators, as well as periodic testing of emergency sirens. Some increase in noise in the area would result from vehicle travel by the permanent workforce. PEF must meet all applicable Occupational Safety and Health Administration (OSHA) noise requirements. Workers would use noise protection as required by OSHA when engaging in work subject to noise hazards. Emergency power equipment would be housed in insulated buildings to reduce noise and would be operated infrequently, primarily for testing and maintenance or during emergency conditions. The pump house would be constructed from noise-attenuating materials, and sounds emitted from it would not exceed the Levy County Noise Ordinance.

A 2008 noise assessment for PEF’s Site Certificate Application to the State of Florida indicated that noise levels at offsite receptor sites would not exceed the Levy County Noise Ordinance and would be below both the ordinance’s daytime and nighttime maximum allowable levels of 65 and 55 dBA outside the site boundary. Noise from plant operations would be within allowable levels at the residences closest to the site. Portions of the Marjorie Harris Carr Cross Florida Greenway are located near the pump house. Thus, pump noise would be audible to visitors near the pump house, but within allowable levels (PEF 2009a). Due to the distance and vegetative buffer that exists between the site and other recreational resources near the site, the review team does not expect any adverse noise impacts. For these reasons, the review team determined the noise-related effect on workers, residents, and recreational users of nearby areas would be minor, and no mitigation would be warranted.

5.4.1.2 Buildings

The distance of the proposed LNP site from offsite buildings means that operational activities would not affect them. Onsite buildings would be constructed to safely withstand any possible shock or vibration from operational activities. No other industrial, commercial, or residential structures would be affected. Consequently, the review team determined that there would be no impacts of operations on onsite or offsite buildings, and mitigation would not be warranted.

5.4.1.3 Roads

Roads near the proposed LNP site would experience an increase in traffic at the beginning and end of each operational shift, at the beginning and end of each outage support shift, and from deliveries made to the site. Section 5.4.4.1 addresses offsite traffic impacts. Commuter traffic would be controlled by speed limits onsite. With the exception of the heavy-haul road, the access roads to the LNP site would be paved. Maintaining good road conditions and enforcing appropriate speed limits would reduce the noise level, particulate matter, and other exhaust generated by the workforce and delivery vehicles entering and leaving the LNP site. Therefore, the review team determined the road-related impacts of operations from noise, dust, and exhaust on workers, residents, and other users of the roads near the proposed site would be minimal, and additional mitigation would not be warranted.

5.4.1.4 Aesthetics

Most of the proposed LNP site would be preserved in its present forested condition, with forest surrounding the industrial area. The tallest buildings, the two containment structures, would be 225 ft high. The cooling towers would be 56 ft high (PEF 2009a). Because of the vegetation screening, the physical structures of the plant would not be visible from public areas at ground level. This includes the closest residences. Only during certain meteorological conditions would the plumes from the cooling towers (not the towers themselves) be visible from a few offsite locations.

Typically, the plumes would extend only a short distance from the site and would dissipate. As discussed in Section 5.7.2, the EPA's CALPUFF dispersion model was used to characterize plume behavior. The model found that less than 2 percent of the time (1 percent during daylight hours) the plume would be visible to surrounding areas more than 1000 m from the site, and the plume would rise to 200 m less than 1 percent of the time. Plumes visible from 5000 m or more are expected to occur during approximately 0.8 percent of the total summer and fall hours. The largest plume elevation would also occur in the summer, with the occurrence of plumes rising 400 m or more during approximately 0.3 percent of the total hours. Occurrences of ground-level fog are not expected beyond 1000 m from the site. Because the nearest road is 1400 m from the site, neither ground-level fog nor icing is expected on nearby roadways as a result of the proposed LNP operation. Odors would not be associated with the cooling-tower plumes.

Due to the vegetation buffer, the LNP's physical structures would not be visible from the closest residences or recreation areas. Ground-level fog and associated icing associated with operation of the cooling towers would dissipate before reaching offsite roads. The noticeable aesthetic effects of the transmission line and corridor, described in Section 4.4.1.4, would continue throughout the life of the project. Based on this information, the review team has determined that the aesthetic impact of operating the proposed LNP would be minor, with the exception of the transmission lines and corridors, and mitigation other than that specified for the transmission-line corridors would not be warranted.

5.4.1.5 Summary of Physical Impacts

Based on the information provided by PEF and its independent review, the review team concludes that all physical impacts of operating proposed LNP Units 1 and 2 would be minor, with the exception of the transmission lines and corridors which would continue to be noticeable, and additional mitigation measures beyond those identified by PEF would not be warranted.

5.4.2 Demography

PEF anticipates employing 773 operations workers at the new units. This includes the 140 operations workers present during preconstruction and construction and the 500 employed by the time of Unit 1 startup. The review team expects 232 (30 percent) of the operations workers would already reside within a reasonable commuting distance from the plant; 541 (70 percent) of the operations workers and their families would migrate into the region and reside within a 1-hour commute of the LNP site. Of the 541 in-migrating workers, the review team expects 80 percent, or 432, to choose to live in the EIA. The Bureau of Economic Analysis (BEA) estimated each job for an in-migrating operations worker in the EIA would support an additional 1.2 indirect jobs (BEA 2009). Therefore, the 432 direct jobs filled by in-migrating workers to the EIA would create an additional 519 indirect jobs in the EIA (432 times 1.2). The review team assumed that the indirect jobs would be filled by people already residing in the region or by family members of in-migrating operations workers and would not add to the number of people migrating into the area as a result of the LNP operations.

The average family size in Florida of 2.49 was applied to the 541 workers who would move to the region, resulting in a total increase in population of approximately 1347 people. This total includes the in-migrating workers and their families present during preconstruction, construction, and at initial startup of LNP Unit 1. The review team estimated that 80 percent of new operations workers (workers migrating into the region) and their families would reside within the EIA (about 202 persons in Levy County, 471 in Citrus County, and 403 in Marion County) and 20 percent (267 people) in the remainder of the region, mostly in Alachua County. Table 5-4 illustrates this distribution in comparison with projected population figures for 2015.

Table 5-4. Potential Increase in Resident Population Resulting from Operating Proposed LNP Units 1 and 2

County	Number of In-Migrating Workforce	Percent of In-Migrating Workforce	Related Increase in Population[(a)]	Projected Population, 2015[(b)]	Percentage Increase in Resident Population
Levy	81	15	202	46,466	0.43
Citrus	189	35	471	161,108	0.29
Marion	162	30	403	393,456	0.10
Alachua	81	15	202	279,666	0.07
Hernando	11	2	27	187,984	0.01
Dixie	5	1	12	18,455	0.07
Sumter	5	1	12	109,294	0.01
Gilchrist	5	1	12	20,714	0.06
Region	541	100	1347	1,313,751	0.10
Total		100.0			

(a) Using an average Florida family size of 2.49.
(b) From Table 2-16 and Appendix G of this EIS.

Partly because of attrition due to the age structure of the regional workforce, partly due to an expanding demand for energy sector workers in Florida, and partly due to the specific skill requirements of the jobs, the review team believes it unlikely that the region could provide enough appropriately skilled workers for many of the operations jobs. Based on review of current operations staffing at CREC (PEF 2009i), the review team determined 30 percent of the positions might be handled by less specialized workers who would come from within the region. This differs from the assumption made in the ER that 100 percent of the operations workers would migrate into the region. To consider the effects of other in-migration assumptions, the effects discussed in this EIS can be multiplied by an appropriate scaling factor.

Table 5-5 shows the review team's projected distribution of operations workers, which differs somewhat from that reported in the PEF ER. The distribution reflects the fact that housing availability is not a constraint. There is ample housing to buy or rent in all counties (Table 4-13).

Table 5-5. Distribution of Operations-Related Workers

County	Percent of Workers	In-Migrating Workers Taking New Operations Jobs[(a)]	Local Workers Taking New Indirect Jobs[(b)]	Local Workers Taking New Operations Jobs	Total Operations-Related Jobs[(c)]	2005 Employment[(d)]
Levy	15	81	97	35	213	15,829
Citrus	35	189	227	81	497	48,761
Marion	30	162	195	70	427	122,098
Alachua	15	81	NA	NA	NA	119,035
Dixie	1	6	NA	NA	NA	5299
Gilchrist	1	6	NA	NA	NA	7198
Hernando	2	11	NA	NA	NA	53,891
Sumter	1	5	NA	NA	NA	24,501
Total	100	541	NA	NA	NA	396,612

(a) 70 percent of workforce jobs filled by in-migrants.
(b) Induced by the new in-migrant jobs, filled locally.
(c) Includes 30 percent of workforce jobs filled locally.
(d) US Department of Labor, Bureau of Labor Statistics (BLS) 2005.
NA = not applicable.

In addition, Citrus County has approved a number of new housing developments (NRC 2009). The distribution assumes that a commute time of 1 hour would be acceptable to many of the workers. Some commute times would be reduced from estimates based on conditions in 2008 because of anticipated road improvements that would be in place by 2017. Primarily because of commute times, the review team assumes that most in-migrating operations workers would reside within the EIA. In contrast with the assumptions made for the construction workforce, the review team expects slightly higher percentages of operations workers to reside in Marion and Alachua Counties. Operations jobs are longer term, and many are higher salaried. Experience at other sites indicates that operations workers may emphasize amenities (shopping, healthcare, or specific recreation opportunities – golf, boating, fishing) and factors such as the quality of local schools and opportunities for spousal employment more than simple commute time or distance. Therefore, Ocala (Marion County) and Gainesville (Alachua County), large cities that require a 1-hour commute, would be more attractive to some operations workers than to construction workers. Within the region, the operations workers and their families are expected to increase the projected 2015 resident population by about 0.10 percent. Within Levy, Citrus, and Marion Counties, they would increase the projected 2015 resident populations by 0.43 percent, 0.29 percent, and 0.10 percent, respectively.

Based on the analysis, the review team concludes that the demographic impacts of operation of the LNP site would be minor.

5.4.3 Economic Impacts on the Community

The impacts of station operation on the local and regional economy are dependent on the region's current and projected economy, tax base, and population. The primary economic impacts of operating the proposed LNP Units 1 and 2 would be related to revenue from new jobs and increased tax payments.

5.4.3.1 Economy

Key assumptions relate to the number, value, and location of new jobs, and where jobholders would reside.

As indicated in Section 5.4.2, the review team assumes 70 percent of the 773 new workers, or 541, would in-migrate from outside the region (distributed as shown in Table 5-4) and that 432 of those in-migrating workers would reside within the EIA. An estimated 514 indirect jobs would be created in the EIA.

The average wage at CREC in 2008 was $79,944. Assuming that wages inflate by 10 percent between 2008 and 2017, the review team assumed an average for LNP salaries of about $88,000 for 2017. This would result in an estimated $68 million in total annual salaries in the region for operations workers, including an estimated $38 million in annual salaries for the in-migrating workers in the EIA and an additional $16 million for annual salaries for EIA area residents who fill operations jobs. Based on the average estimated median household income for the EIA in 2005–2007, the review team estimated that the new indirect jobs would provide $22 million in salaries in the 50 mi, including $19 million in the EIA (USCB 2009a, b, c), for a total earnings per year of $73 million in the EIA once both plants are operating.

BEA (2009) stated that the earnings multiplier for utility industry jobs in the EIA is 1.4. As a check on the aforementioned earnings estimate, the review team applied the earnings multiplier to estimated annual operations salaries in the EIA, resulting in an estimated $69 million economic impact (1.4 times $38 million for in-migrating workers plus $16 million for local residents who fill operations jobs).

Drawing on the assumptions as explained, Table 5-5 shows the assumed distribution of all operations jobs in comparison with 2005 employment figures. The increase in total employment would be 1137 jobs in the EIA. The table demonstrates that the direct and indirect jobs related to operation of the proposed LNP would be a small percentage of the total 2005 jobs in the EIA.

The $73 million annual earnings from direct and indirect new jobs associated with LNP operation by in-migrating and local residents of the EIA is less than 2 percent of the approximately $6 billion total 2005 earnings in these counties shown in Table G-5 in Appendix G. The $54 million annual earnings in the region from direct jobs at the plant represents more than 30 percent of the approximately $170 million total 2005 earnings in the transportation and utility sector in the EIA shown in Table G-5. Thus, LNP operations would noticeably boost employment in that sector but have little effect on overall regional employment. For Levy County, the annual earnings of incoming workers and associated indirect jobs would total about $10.5 million, slightly less than 3 percent of 2005 earnings in the county. For Marion and Citrus Counties, the percentage effect would be smaller in spite of the presence of more incoming operations workers because of the larger size of their economies.

The operation of proposed LNP Units 1 and 2 would also increase the workforce by an additional 800 workers during scheduled outages for about 25 to 30 days every 9 months. This outage workforce would be composed of contract employees to perform equipment maintenance, refueling, and special outage projects at the site. To stay as close as possible to the LNP site, most of the outage workers would stay in local hotels, rent rooms in local homes, or bring travel trailers. The earnings and expenditures associated with these temporary workforce increases would be 5 percent or less of those discussed for the permanent operations workforce.

The overall impact on the economies of the region and the EIA from operating proposed LNP Units 1 and 2 would be minor and positive.

5.4.3.2 Commercial and Recreational Fishing

In addition to the positive job-related impacts, operating a nuclear power plant could have a negative impact on other aspects of the economy. In particular, the impingement, entrainment, and thermal effects of the water uptake and discharge for the plant could affect commercial and recreational usage of fish species. Based on the information in Section 5.3.2.3, the review team determined the impact on commercial and recreational fishing from the operation of proposed LNP Units 1 and 2 would not be noticeable.

5.4.3.3 Taxes

Tax revenue categories that would be affected by the operation of proposed LNP Units 1 and 2 include sales and use taxes, corporate income tax, and property taxes. The State of Florida does not collect an individual income tax.

Sales and Use Taxes

The $73 million in earnings from operations jobs and associated indirect jobs in the EIA once both units are in operation is less than half of the almost $170 million earnings created by LNP jobs in this area during peak construction and preconstruction employment. Using the same assumptions applied in Section 4.4.3.3, this would generate about $1.2 million in annual State sales tax revenue with less than $100,000 as the one-half percent share reaching the individual county governments in the EIA. This is a negligible amount when compared to annual tax revenue in each of these counties.

The annual value of purchases subject to sales and use taxes would be much less during operations than during preconstruction and construction. Assuming the level of operations-related purchases to be about 10 percent of the preconstruction- and construction-phase annual level, the operations-related sales tax revenue for the region would be less than $500,000, and the added use tax for the State would be about $3 million. These revenues are negligible when compared to annual sales and use tax revenues at the county and State levels.

Corporate Income Tax

PEF would pay corporate income taxes of approximately 5.5 percent of its net State income. These taxes would go directly to the State of Florida. Unlike sales tax, there is no specified return to the region or county of revenue generated by corporations within them. Given the magnitude of Florida's State budget, the review team concludes that the impact on the State would be minor and positive.

Property Taxes

As indicated in Section 4.4.3.3, once each unit begins operating, the value of the LNP property would be assessed at the value of construction cost, less the cost of pollution-control components, or approximately three-quarters of the total construction cost. Property (ad valorem) taxes will then be applied to this assessed value, approximately $10.6 billion when both LNP Units 1 and 2 are operational. Using the 2008 millage rate of 15.78, the review team estimated an annual payment of $63 million when Unit 1 comes on line, increasing to $104 million when Unit 2 is operational. Compared to Levy County's $18 million tax revenue and $38.8 million total revenue in 2006, these increases would have a noticeable and substantial positive impact.

The review team recognizes that some operations workers would purchase new homes that also would generate new property taxes. Given the magnitude of the local tax base in the EIA, this additional revenue would constitute a small percentage increase. Therefore, the review team determined that the impact of operations of proposed LNP Units 1 and 2 on residential property tax revenues would be minor.

Summary of Tax Impacts

The review team expects tax revenue increases in the form of sales, use, corporate income, and property taxes because of the operation of the proposed LNP units and the influx of operations workforce into the region. This impact, however, is likely to be minimal for all locations except Levy County, which would experience a noticeable and substantial increase in property tax revenue.

5.4.3.4 Summary of Economic Impacts on the Community

Based on the information provided by PEF, review team interviews with local public officials, and NRC's independent review of data about the region's economy and taxes, the review team concludes that the impacts on the region's economy of operating the proposed units at the LNP site would be SMALL and beneficial for all counties except Levy, which would experience a LARGE positive increase in tax revenue.

5.4.4 Infrastructure and Community Services

This section describes the estimated impacts on infrastructure and community services, including transportation, recreation, housing, public services, and education.

5.4.4.1 Transportation

The effects of LNP operation on transportation and traffic would be greatest on US-19, the north-south highway that provides the main access to the LNP site. Primary access to the site during operations would be via a new main driveway intersecting with US-19 south of the construction driveway. The review team determined operations impacts in a manner similar to that used to evaluate the construction and preconstruction impacts in Section 4.4.4.1.

The analysis draws on a traffic study (Kimley-Horn 2009) that considered the number and timing of operations worker vehicles on the road for two shifts that correspond to the a.m. and p.m. peak hours, the number and timing of truck deliveries per day, the projected population growth rate in Levy County, and the capacity and usage of the road system. As explained in Section 4.4.4.1, the Kimley-Horn (KH) study adopted Levy County's level of service (LOS) standards for roads in the county (Levy County 2009). KH used 24-hour traffic counts collected in July 2008 from a previous study performed by Linck and Associates (Kimley-Horn 2009), 2007 24-hour counts from the Florida Department of Transportation, and p.m. peak-hour counts collected in November and December 2008 by KH staff (Kimley-Horn 2009).

The review team agreed with the assumption in the KH study that the same major travel routes described in Section 4.4.4.1 would be used by operations workers to commute to and from the LNP site with a similar directional split. The study estimated vehicle usage by the operations workforce in 2017, the first year when both proposed LNP Units 1 and 2 would be operating. The study assumed that turn-lane improvements and signal controls described in Section 4.4.4.1 would remain in place after construction and identified the need for the construction of turn lanes, but no traffic signal, at the intersection of US-19 with the main (operations) driveway to accommodate the operations workforce. The KH study did not include consideration of traffic effects of a proposed northward expansion of the Suncoast Parkway into Citrus County that could be completed before or soon after the proposed LNP units are operational. The parkway extension, currently planned as a toll road, is intended to link the Veterans Expressway in Tampa with US-19/US-98 in northern Citrus County, south of the proposed LNP site. Because there is sufficient capacity on the existing roadways to accommodate the operations workforce, completion of the Suncoast Parkway northern extension could only help reduce the effect of the operations workforce on the surrounding road network. Not including it in the analysis provides an upper bound on expected traffic impacts. The review team agrees with the KH study approach of excluding the effects of the Suncoast Parkway to avoid underestimating potential operational impacts. Nevertheless, if the Suncoast Parkway were completed, it would help move traffic to and from the site to Citrus County and south to Tampa. During outages, planned to occur every 9 months, an additional 800 outage workers would be onsite for a period of 25 to 30 days. Outage workers would access the LNP site through the construction entrance on US-19/US-98, not the main (operations) driveway. Trucks delivering new reactor fuel, equipment, and materials also would use the construction driveway. The outage workforce and refueling freight traffic would be much less than traffic during peak construction employment. Consequently, the turn lanes and traffic signal installed to accommodate construction and preconstruction traffic would also accommodate the traffic associated with outages.

Because the number of operations workers is less than a quarter of the number of construction and preconstruction workers at peak, the review team determined that traffic impacts from operations would be smaller than those estimated for construction and preconstruction. Based on its review of the KH traffic study and assuming implementation of the study’s mitigation recommendations, the review team finds that there would be minimal impacts on the road network with the exception of an expected discernable impact at the intersection of US-19 with the construction driveway at shift change during outages. However, given that outages would only occur for 1 out of every 9 months and would be limited to shift changes, the review team determined the overall traffic-related impact would be minimal.

5.4.4.2 Recreation

A detailed description of the local availability and use of recreational facilities is provided in Section 2.5.2.4. The physical impacts of operation of proposed LNP Units 1 and 2 are discussed in Section 5.4.1. Impacts from increased demand or use would be similar to, but smaller than, the construction and preconstruction impacts described in Section 4.4.4.2 because the in-migrating operations workforce would be smaller than the construction workforce. Given that the construction- and preconstruction-related impacts on recreation were deemed minor, the review team concludes the impacts of plant operations on recreation in the EIA and within 50 mi of the proposed LNP site would be minimal.

5.4.4.3 Housing

The assumptions underlying the review team's estimated in-migration of operations workers were provided in Section 5.4.3. Seventy percent, or 541 workers, of the total operations workforce of 773 workers would be expected to move into the region; 432 of the workers would reside within the EIA – 81 in Levy, 189 in Citrus, and 162 in Marion. Overall, this represents a decrease in the number of workers migrating into the region and EIA compared to those expected during construction and preconstruction.

Section 2.5.2.5 states that there were 37,784 vacant units and 78,889 housing units for rent or sale in the EIA in 2000. The review team determined there currently is enough available housing to support the maximum influx of workers and their families (1347 total people) into the region, particularly in the EIA where 1076 new people (workers and their families) are expected to reside. Because the available housing within the EIA exceeds the number of operations workers expected to move into the area for the proposed LNP, the review team anticipates no shortage of housing or developable land and, therefore, no upward pressure on housing prices.

Marion and Citrus Counties, which have more available housing than Levy County, may experience an increase in housing demand or a shift in demand toward relatively higher-value houses. Levy County may notice a shift toward construction of new homes due to the age and condition of the existing housing stock within the county. New construction to accommodate operations workers and their families within Levy County's town of Inglis, the closest community to the proposed LNP site, would be limited because there is no public sewer service. Inglis regulates 1 house per ac or 1 house per 5 ac near the coast (NRC 2009).

The 800 outage workers likely would stay in area apartments, hotels, motels, or camping/recreational vehicles (RVs) areas dispersed throughout the EIA. The analysis of housing availability for the construction workforce in Section 4.4.4.3 and Table 4-13 indicates that the supply of public lodging and camping and/or RV areas is sufficient to accommodate the influx of temporary workers within the EIA, and no single community would be expected to be overburdened by the influx of temporary workers.

Given the ample supply of available housing in the EIA and region, the review team determined that the overall impact on housing demand and prices from plant operations over the expected 40-year life would not be noticeable.

5.4.4.4 Public Services

This section describes the available public services and discusses the impacts of construction and preconstruction at the proposed LNP site on water supply and waste treatment; police, fire-protection, emergency, and medical services; and education, in the region with a focus on the EIA.

Water-Supply Facilities

The proposed LNP would use an average of 35 gpm with a maximum of 69 gpm of potable water from onsite wells. Because of the availability of groundwater at the site, assumed permit compliance, and the site's independence from municipal water supplies, the review team has determined plant operations would have minimal impact on this water resource.

Using the same assumptions presented in Section 4.4.4.4, the review team calculated the increase in demand for residential water attributable to the in-migrating operations workers and their families. The demand for water within the EIA would increase by 0.161 Mgd of potable water. This increase, slightly less than a 0.2 of 1 percent increase over projected water demand in the EIA without the in-migrants, would be spread proportionally among the counties according to the distribution of workers discussed in Section 5.4.2, resulting in an increase of 0.43 percent in Levy County, 0.29 percent in Citrus County, and 0.10 in Marion County. To the extent operations workers purchase existing homes, their demand for water would already be planned. However, some in-migrating operations workers may decide to have new homes built, which would increase demand for water and sewer services in the EIA. For purposes of this analysis, the review team assumes full conformance with local municipal regulations and permit requirements to demonstrate sufficient water capacity prior to the approval of new construction. Given the small increase in demand that would result from the operations workers and their families who move into the area, the review team has determined that operations-related impacts on the water supply in the EIA would not be noticeable, and no mitigation would be warranted.

Wastewater-Treatment Facilities

The proposed LNP would have a private wastewater-treatment facility with capacity of 80,000 gpd, sufficient to serve the operations workforce, as well as additional workers during planned outages.

The review team calculated the increase in wastewater treatment that would be required in the EIA during operations due to in-migrating workers and their families. Using an average of 110 gpd per person for in-migrating workers and their families (Marion County's LOS standard, highest among those reported in Section 2.5.2.6) and 2015 population projections from Table 2-16, wastewater-treatment needs would be 0.118 Mgd for the new construction and preconstruction workers and families and onsite workers during peak construction employment. As with water demand, this increase in wastewater-treatment needs would be slightly less than 0.2 of 1 percent increase over projected water-treatment demand in the EIA without the in-migrants and would be spread among the counties according to the distribution of workers discussed in Section 5.4.2. The estimated increase as a result of the in-migrating operations workers and their families is 0.43 percent in Levy County, 0.29 percent in Citrus County, and 0.10 in Marion County. As with the discussion of water services, new home construction may call for additional wastewater infrastructure to areas that are not currently served. For purposes of this analysis, the review team assumes full conformance with local municipal regulations and permit requirements to demonstrate sufficient wastewater capacity prior to the approval of new construction. Given the small increase in demand that would result from the operations workers and their families who move into the area, the review team has determined that operations-related impacts on the wastewater-treatment capabilities in the EIA would not be noticeable, and no mitigation would be warranted.

Police, Fire-Protection, Emergency, and Medical Services

Section 5.4.4.3 discusses the distribution of housing for in-migrating operations workers and their families in the EIA. The additional population amounts to less than 0.2 of 1 percent increase in Levy, Citrus, and Marion Counties over 2015 projections. This long-term population increase would potentially add to the workload for police, fire-protection, and emergency services and increase the number of users of local medical facilities. However, such small numbers should not noticeably affect performance, except in localities where services currently are near or over capacity.

The review team used the same approach presented in Section 4.4.4.4 to evaluate the potential impacts on the services. Differences are long-term residency of operations staff, smaller total numbers, a slightly different allocation of workers in the EIA, availability of substantial property tax revenues to Levy County, and timing – the EIA will already have adapted their capabilities to address the demands created during the building phase, as described in Section 4.4.3. The review team anticipates the project-related population and activities would add a minor increment to the demand for police and emergency services by the residents of the EIA. Locally, for the Inglis police and emergency services, the review team expects a short-term noticeable impact until Levy County is able to draw on tax revenues to supplement Inglis resources as needed. Likewise, the review team would expect noticeable impacts on the city of Dunnellon police and emergency services because police services already are at capacity, and the community is expected to attract a number of the operations workers. The review team determined that, given the 40-year life of the proposed two units, all of the noticeable impacts would be mitigated to a minimal level by readjustment of community resources.

The review team expects little impact on fire-protection services in Marion and Citrus Counties because they already have available capacity. Because the current fire-protection services in Levy County are at capacity, the review team expects that even the small increase in demand for fire-protection services in Levy County would prolong the noticeable impact discussed in Section 4.4.4.4 until services could be added using property tax revenue.

Given the current 16-percent vacancy rate in the region's hospitals, the review team expects minor impacts on access to medical care in the region. The increase represented by a population increase of about 0.1 of 1 percent would fill only a small part of those vacancies.

5.4.4.5 Education

As indicated in Section 5.4.2, the review team projects that 80 percent of incoming workers and their families would settle within the EIA, resulting in 189 new households in Citrus County, 81 in Levy County, and 162 in Marion County. The review team used county school district estimates of students per household from Table 2-35 to calculate the added students attributable to in-migrating operations worker households, as shown in Table 5-6.

Table 5-6. Expected Number of Students from In-Migrating Operations Worker Households

	Elementary School Students	Middle School Students	High School Students	Total Students
Levy County	16	9	9	34
Citrus County	22	11	13	47
Marion County	26	13	15	53
EIA	64	32	37	134

Values calculated using county school district estimates of students per household from Table 2-35 in Chapter 2 and number of in-migrating workers per county from Table 5-4.

The addition of 134 students would be a small number added to the existing rolls (approximately 66,000 in 2007–2008 as indicated in Section 2.5.2.7).

As indicated in Section 2.5.2.7, there are capacity issues in Levy County schools, including the Yankeetown School, which is closest to the proposed LNP site, and in Marion County schools, including Dunnellon High School and the elementary school closest to the LNP site. Because the State of Florida mandates that new development cannot be approved without appropriate accommodations for school-age children, the review team assumes that school capacity would be available for any locations where operations workers might build housing.

Levy County can anticipate an increased tax base once proposed LNP Unit 1 is operational, which could provide funding for expansion of Yankeetown School beginning in 2017, including the addition of a high school. Levy School District staff indicated it has available land for expansion, but lacks the budget (NRC 2009). The addition of a high school in Levy County would alleviate crowding at Dunnellon High School, even if some operations workers settle in Dunnellon.

Based on these considerations, the review team has determined that operation of the proposed LNP would have little impact on EIA school capacity with possible short-term impact on Yankeetown School and Dunnellon High School until additional capacity is provided in Levy County.

5.4.5 Summary of Socioeconomics Impacts

The review team determined that the physical effects of plant operations would be SMALL, with the exception of a continued MODERATE aesthetics impact from the transmission lines and corridors. Economic, demographic, and tax impacts would be SMALL and beneficial except for Levy County where tax impacts would be LARGE and beneficial. Impacts on infrastructure and community services would be SMALL except for short-term extension of MODERATE impacts on police and emergency services in Inglis and Dunnellon; fire-protection services in Levy County; and schools serving Inglis, Yankeetown, and Dunnellon. The review team determined that in the long term once local funding has been adjusted, all of these MODERATE impacts would reduce to SMALL.

5.5 Environmental Justice

The review team evaluated whether minority and low-income populations identified in Section 2.6 of this EIS could experience disproportionately high and adverse impacts from the operation of two reactors at the proposed LNP site. In this evaluation, the review team also included populations of particular interest due to their unique characteristics. To perform this assessment, the review team used the same process described in Section 4.5. The review team reviewed the ER prepared by PEF and verified the data sources used in its preparation by examining cited references and by independently confirming data in discussions with community members and public officials (NRC 2009). To verify data in the ER, the review team requested clarifications and additional information from PEF as needed. Unless otherwise specified in the sections that follow, the review team has drawn upon verified data from PEF (2009a, c, e, i, j). Where the review team used different analytical methods or additional information for its own analysis, the sections include explanatory discussions and citations for additional sources.

5.5.1 Health Impacts

For all three health-related considerations, the review team determined through literature searches and consultations with NRC staff health physics experts that the expected operations-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations, and therefore cannot impose a disproportionately high and adverse radiological health effect on minority or low-income populations.

The results of the normal operation dose assessments (see Section 5.9) indicate that the maximum individual dose for the pathways identified in Section 5.9 was found to be insignificant, that is, well below the NRC and EPA's regulatory guidelines. Because there would be no significant adverse health impacts on the most exposed members of the public, there would be no disproportionately high and adverse health impacts on any minority and low-income populations. Therefore the environmental justice impacts from operations would be minimal.

As discussed in Section 5.8.5, nonradiological health impacts from emissions during the operation period on the public and onsite workers would be minimal. The review team has not found any environmental pathway that would lead to offsite nonradiological health effects that would create a disproportionately high and adverse impact on any minority or low-income populations. For example, any increase in traffic accidents due to heavier traffic is unlikely to have a disproportionately high and adverse impact on any particular population subgroup. Section 5.2.3 states the effects of Unit 1 and 2 discharges would be minimal on water quality. In addition, Section 5.8 found that health impacts on the public and workers from etiological agents, noise generated by plant operations, and acute impacts of EMF from power lines would be minimal. The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts. Furthermore, as discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in health pathway impacts that are different from those of the general population. Therefore, the potential impacts of nonradiological effects resulting from the operation of the proposed two units would be minimal and there would be no disproportionately high and adverse impacts felt by minority or low-income populations within the analytical area. Therefore, the environmental justice impacts on health derived from operating the proposed units at LNP would be SMALL.

5.5.2 Physical and Socioeconomic Impacts

As shown in Figure 2-26, all census block groups with minority and low-income populations that meet the criteria discussed in Section 2.6 are located 10 mi or farther away from the LNP site. The closest minority populations (both aggregate and African-American) are in Citrus County between Citrus Springs and Dunnellon, approximately 10 mi from the site. The closest low-income populations, near Otter Creek in Levy County, are almost 20 mi from the site. There are concentrations of block groups with African-American populations around the communities of Otter Creek, Usher, Chiefland, and Williston in Levy County between 20 and 30 mi from the site; around Ocala in Marion County, about 30 mi from the site; around Gainesville in Alachua County, about 45 mi from the site; and in the northwest corner of Sumter County, between 20 and 30 mi from the site. (These are linear distances from the LNP site center; driving distances to all communities are greater). Some block groups with low-income populations of interest overlap with African-American populations of interest around Otter Creek, Usher, and Chiefland in Levy County and around Ocala (Marion County) and Gainesville (Alachua County).

The review team determined that there would be no disproportionately high and adverse physical impacts on minority or low-income people within the identified census blocks. Distance from the site and intervening vegetation would mitigate physical impacts of operations on soil, water, noise, and air such that they would be minimal for all populations, including the minority and low-income populations closest to the site.

The review team assessed socioeconomic impacts discussed in Section 5.4 to evaluate whether any operations-related activities could have a disproportionately high and adverse effect on minority or low-income populations. The review team determined that the physical effects of plant operations would be SMALL, with the exception of a continued MODERATE impact from the transmission lines and corridors. Economic, demographic, and tax impacts would be SMALL and beneficial except for Levy County where tax impacts would be LARGE and beneficial. Impacts on infrastructure and community services would be SMALL except for short-term extension of MODERATE impacts on police and emergency services in Inglis and Dunnellon; fire-protection services in Levy County; and schools serving Inglis, Yankeetown, and Dunnellon. The review team determined that in the long term once local funding has been adjusted, all of these MODERATE impacts would reduce to SMALL.

As discussed in Section 2.6.2 of this EIS, the review team did not identify any evidence of unique characteristics or practices in minority or low-income communities that may result in socioeconomic impacts different from those on the general population. Therefore, the review team found no evidence that impacts on the minority and low-income populations in these instances would be disproportionately high and adverse as compared to other populations.

Based on the above analysis, the review team determined that the environmental justice impacts from physical and socioeconomic sources would be minor.

5.5.3 Subsistence and Special Conditions

The NRC's environmental justice methodology includes an assessment of populations with unique characteristics or practices; e.g., minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements or high-density concentrations of minority populations.

5.5.3.1 Subsistence

Subsistence fishers and hunters, like recreational fishers and hunters, may choose to move to locations away from operations impacts for aesthetic or experience-based reasons, but such voluntary relocation would not be excessively burdensome given that other nearby locations are available. Consequently, because the review team did not identify any pathway that could lead to a disproportionately high and adverse impact on subsistence resource users, the review team concludes that there would be no such impacts related to subsistence activity among minority and low-income populations due to LNP operations.

5.5.3.2 High-Density Communities

As discussed in Section 2.6.2, the review team determined that there are no high-density communities within the vicinity of the LNP site or along any pathway that might lead to disproportionately high and adverse impacts.

5.5.4 Summary of Environmental Justice Impacts

The review team expects the physical impacts of plant operation on all populations in the region, including minority and low-income populations, would be SMALL because of their distance from the site. The adverse socioeconomic impacts on minority and low-income populations also are expected to be in proportion with the impacts discussed in Section 5.4 for the overall population and, therefore, are SMALL for most elements and MODERATE in the short term for education, police, emergency services, and fire protection in certain locations. The review team determined that in the long term once local funding has been adjusted, all of these MODERATE impacts would reduce to SMALL. In these locations, there is no evidence that impacts would be disproportionately high and adverse on minority or low-income populations or to communities with unique characteristics or practices. Based on the preceding analysis, the review team concludes that there are no disproportionately high and adverse impacts on minority and low-income populations resulting from operation of LNP, and environmental justice impacts would be SMALL.

5.6 Historic and Cultural Resources Impacts from Operations

The National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321, et seq.), requires Federal agencies to take into account the potential impacts of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA), also requires Federal agencies to consider impacts on those resources if they are eligible for listing in the National Register of Historic Places (NRHP or National Register) (such resources are referred to as “Historic Properties” in NHPA). As outlined in 36 CFR 800.8 (c), “Coordination with the National Environmental Policy Act of 1969,” the NRC is coordinating compliance with NHPA Section 106 to fulfill its responsibilities under NEPA.

Operating new nuclear power plants can affect either known or potential historic properties that may be located at the site. In accordance with NHPA and NEPA provisions, the NRC and the USACE are required to make a reasonable and good faith effort to identify historic properties in the Areas of Potential Effect (APE) and, if such properties are present, determine whether significant impacts are likely to occur. Identification of historic properties is to occur in consultation with the State Historic Preservation Office (SHPO), Native American Tribes, interested parties, and the public. If significant impacts are possible, then efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties (i.e., places eligible for listing in the National Register) are present or affected, the NRC and USACE are still required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC and USACE are required to assess and resolve any adverse effects of the undertaking.

For a description of the historic and cultural resources at the LNP site, see Section 2.7. PEF concluded that no known cultural resources exist within the direct or indirect APEs and issued a determination of “no historic properties affected” concurred with by the Florida SHPO (Florida SHPO 2008).

PEF has procedures in place for informing managers and workers to stop work if cultural materials or human remains are inadvertently discovered during operations and to notify staff within the appropriate Environmental Support Organization (ESO) (PEF 2008c, 2009a). All work would be halted while the permitting specialist from within the ESO consults with the Florida SHPO. Any land-disturbing activity that affects a cultural resource would require a cultural resource assessment. In addition, if any area proposed for disturbance by construction is near known cultural resources, the appropriate staff within the ESO should be notified (PEF 2008c).

For the purposes of NHPA 106 consultation, based on (1) no known historic properties within the APEs, (2) the review team’s cultural resource analysis and consultation, (3) PEF’s commitment to follow its procedures if ground-disturbing or maintenance activities discover historic or cultural resources, and (4) PEF’s consultation with the Florida SHPO that concluded a finding of “no historic properties affected” (Florida SHPO 2008), the review team determines a finding of no historic properties affected (36 CFR Section 800.4(d)(1)).

For the purposes of the review team’s NEPA analysis, based on (1) no known significant cultural resources within the APEs, (2) the review team’s cultural resource analysis and consultation, (3) PEF’s commitment to follow its procedures should ground-disturbing or maintenance activities discover historic or cultural resources, and (4) PEF’s consultation with the Florida SHPO that concluded a finding of “no historic properties affected” (Florida SHPO 2008), the review team concludes that the impacts from operation would be SMALL. Mitigative actions may be warranted only if an unanticipated discovery is made during any ground-disturbing activities associated with maintenance of the operating facility; these actions would be determined by PEF in consultation with the Florida SHPO. PEF has cultural resource management procedures in place (PEF 2008c).

5.7 Meteorology and Air Quality Impacts

The primary impacts of operation of two new nuclear units on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system mechanical draft cooling towers, operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.7.2. Section 5.7.1 covers potential air quality impacts from nonradioactive effluent releases at the proposed LNP site, and Section 5.7.3 covers the potential air quality impacts of transmission lines during plant operation.

5.7.1 Air Quality Impacts

Standby diesel generators and auxiliary power systems would be used for emergency power and auxiliary steam purposes. These systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides [NO_x]) would be permitted in accordance with Florida State and Federal regulatory requirements.

A Prevention of Significant Deterioration (PSD) Permit application for the standby and auxiliary systems has been submitted to the State of Florida (FDEP 2009b). These systems include the following (PEF 2009a):

- four standby generators rated at 4000 kW
- four ancillary generators rated at 35 kW
- two diesel-driven fire pumps rated at 7571 Lpm
- two fuel oil storage tanks.

Based on estimates provided by PEF (2008a), the annual release of criteria pollutants at the LNP related to the operation of the generators and fire pumps are listed in Table 5-7.

Because these systems would be used on an infrequent basis (i.e., typically 4 hours per month), the staff concludes the environmental impact of the pollutants from these sources would be minimal, and additional mitigation would not be warranted.

Finally, the operation of a nuclear power plant involves the emission of some greenhouse gases, primarily carbon dioxide (CO_2). The review team has estimated that the total carbon footprint for actual plant operations of LNP Units 1 and 2 for 40 years is of the order of 280,000 MT of CO_2 equivalent, as compared to a total U.S. annual CO_2 emissions rate of 6,000,000,000 MT (EPA 2010b). Workforce transportation accounts for about 90 percent of the

Table 5-7. Regulated Source Emissions (lb/yr)

Source	PM[a]	SO_x[b],	CO[c]	VOC[d]	NO_x[e]	CO_2[f]
Four standby generators[g]	2168	111	6645	2518	30,848	1,147,171
Four ancillary generators[g]	33	1.6	101	38	467	17,381
Two fire pumps[g]	136	6.4	415	157	1928	71,698

Source: PEF 2009a
(a) PM = particulate matter.
(b) SO_x = oxides of sulfur.
(c) CO = carbon monoxide.
(d) VOC = volatile organic compounds.
(e) NO_x = oxides of nitrogen.
(f) CO_2 = carbon dioxide.
(g) Assumes 4 hours per month operation for each generator or fire pump and Number 2 diesel fuel with sulfur content of 0.05 percent.

total. Periodic testing of diesel generators accounts for most of the rest. These estimates are based on carbon footprint estimates in Appendix I and emissions data contained in the ER (PEF 2009a). Based on its assessment of the relatively small plant operations carbon footprint compared to the U.S. annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable, and additional mitigation would not be warranted.

The review team has considered the timing and magnitude of atmospheric releases related to operation of proposed Units 1 and 2, the existing air quality at the LNP site and the distance to the closest Class I Federal Area, and PEF's commitment to manage and mitigate emissions in accordance with applicable regulations. On these bases, the review team concludes that the air quality impacts of operation of proposed LNP Units 1 and 2 would not be noticeable. Based on its assessment of the carbon footprint of plant operations, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would be insignificant.

5.7.2 Cooling-System Impacts

The proposed cooling system for the LNP site consists of two mechanical draft cooling towers associated with the CWS and two smaller mechanical draft cooling towers associated with the service-water system. Mechanical draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air, and this process can lead to condensation and the formation of a visible plume. Aesthetic impacts from the visible plume; land-use impacts from cloud shadowing, fogging, icing, increased humidity; and drift from dissolved salts and chemicals found in the cooling water can result.

The EPA-approved CALPUFF model was selected to estimate the visual impacts associated with operating the cooling towers. One year of data (January 1 through December 31, 2003) collected at Gainesville, Florida, was used as input to the CALPUFF model. The analysis indicates that the vast majority (nearly 98 percent) of all plumes would be less than 100 m in length and rise less than 200 m (PEF 2009a) regardless of the season. In general, the longest plumes would occur in the summer and fall. Plumes extending 5000 m or more are expected to occur during approximately 1.7 percent of the total summer and fall hours. The largest plume rise would also occur in the summer, with plumes that rise 400 m or more occurring during approximately 0.3 percent of the total hours. Ground-level fogging or icing was limited to locations within 1000 m of the cooling towers. The towers are approximately 1400 m from the nearest roadway (US-19), so ground-level fogging is not expected to affect local roads.

The particulate matter emissions from the cooling towers consist of naturally occurring dissolved solids that originate with the cooling water removed from the CFBC. The concentration of TDS in the CFBC is assumed to be 25 ppt and consist of only salts. On average, the salinity of the world's oceans is 35 ppt (ONR 2009), but the salinity of the CFBC is reduced by flow from Lake Rousseau and other tributaries. Water leaves the cooling towers as either pure water vapor or as small water drops. These drops are referred to as "cooling-tower drift," and drift eliminators are used to limit the drift to 0.0005 percent of the water flowing through the cooling towers. Emission of particulate matter and salt deposition only occur for water drops that escape from the cooling towers as drift. In operation, the cooling towers will evaporate up to 1,682,400 gph (PEF 2009a). This water will leave the cooling towers as pure water vapor. In comparison, the total amount of dissolved solids that could leave the cooling towers as drift is estimated to be 115.7 lb/hr during normal operations and 154.26 lb/hr during short-duration excursions. The particulate matter emissions from the cooling towers would be classified by the State of Florida as a major source because emissions would exceed the State's threshold of 100 T/yr. A PSD Permit for air emissions has been prepared and submitted to the State (PEF 2009a). An analysis of the deposition of salts from the cooling-tower drift was conducted using the EPA-approved AERMOD model and 5 years of surface data collected at Gainesville and upper air observations from Jacksonville, Florida. Using the source terms described and the AERMOD results, the maximum predicted offsite deposition rate during normal operations is 6.81 kg/ha/mo at a location west of the cooling towers. The salt deposition decreases rapidly with distance from the plant. The maximum predicted onsite deposition is 10.75 kg/ha/mo. Deposition rates between 1 and 2 kg/ha/mo are normally not damaging to plants, while rates approaching 10 kg/ha/mo can cause leaf damage (NRC 2000a). The terrestrial ecological impacts due to salt deposition associated with cooling tower drift are discussed in more detail in section 5.3.1.1 of this EIS.

5.7.3 Transmission-Line Impacts

The impacts of existing transmission lines on air quality are addressed in the *Generic Environmental Impact Statement for License Renewal* (NRC 1996). Small amounts of ozone and even smaller amounts of NO_x are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be costly and not warranted.

Up to four new 500-kV transmission lines would be constructed to accommodate the new power-generating capacity (PEF 2009a). This size is well within the range of transmission lines provided in the GEIS. On this basis, the staff concludes that air quality impacts from transmission lines would be minimal, and additional mitigation would not be warranted.

5.7.4 Summary of Meteorology and Air Quality Impacts

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating LNP Units 1 and 2. The review team also evaluated potential impacts of cooling-system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of LNP Units 1 and 2 on air quality from emissions of criteria pollutants, CO_2 emissions, cooling-system emissions, and transmission line impacts would be SMALL, and no further mitigation would be warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological human health impacts on the public and workers from operating the proposed new nuclear Units 1 and 2 at the LNP site. Nonradiological public health impacts are considered from operation of the cooling system, noise generated by operations, EMF, and transporting materials and personnel to the site. Nonradiological health impacts from the same sources are also evaluated for workers during the operation of proposed Units 1 and 2. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the LNP site. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological Agents

Operation of proposed LNP Units 1 and 2 would result in a thermal discharge through the CREC to the Gulf of Mexico (PEF 2009a). The staff investigated the possibility of the thermal discharges to increase the growth of thermophilic microorganisms, including those that can cause diseases (etiological agents), in both the CWS and the Gulf of Mexico. In addition, growth of thermophilic organisms in the cooling tower might pose a health risk during occupational exposures. As discussed in Section 2.10.1.3, the types of organisms of concern include enteric pathogens (such as *Salmonella* spp., *Pseudomonas aeruginosa, and Shigella sonnei*), thermophilic fungi, bacteria (such as *Legionella* spp. and *Vibrio spp.*), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels (NRC 1996).

The discharge of blowdown water to the CREC is expected to have minimal effects on the total thermal discharge to the Gulf of Mexico. The discharge volume from the proposed LNP would contribute only 4.4 percent of the total discharge flow, and the temperature of the LNP blowdown actually would be slightly below the average temperature of the current CREC discharge (PEF 2009a, i). In addition, recreational exposure to thermophilic organism in the discharge from the CREC is likely to be minimal because access to the discharge channel is strictly limited by buoys and barricades, and the restriction is enforced by armed guards. No fishing or shellfishing is allowed near the discharge channel (PEF 2009i).

Because the addition of the proposed LNP discharge to the CREC is expected to have minimal impact on the temperature of the discharge plume and due to significant physical and administrative barriers to prevent contact with blowdown, the potential for human exposure to thermophilic organisms from operation of the proposed LNP is low. Thus, the staff concludes that the impacts of thermal discharges from proposed LNP Units 1 and 2 on human health would be minimal, and mitigation would not be warranted.

5.8.2 Noise

In NUREG-1437 (NRC 1996), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers and transformers with intermittent contributions from loud speakers and auxiliary equipment, such as diesel generators.

The primary sources of noise from proposed LNP Units 1 and 2 operations would be the

- mechanical draft cooling towers and circulating-water pumps
- CWIS makeup-water pump house that would be located adjacent to the CFBC, approximately 3.5 mi south of the center of the main plant site near County Road (CR) 40.

The Levy County Noise Ordinance (Levy County Code 50-349) limits sound levels experienced by offsite receptors due to industrial activities. For residential, rural agricultural, and commercial districts, the maximum allowable noise level at the property line is 65 dBA for the hours between 7:00 a.m. to 10:00 p.m. For industrial districts, the maximum allowable noise level is 75 dBA at all times. Allowable noise limits are lower from 10:00 p.m. to 7:00 a.m. in residential areas (55 dBA) and rural districts (60 dBA).

As discussed in Section 4.8.2, a noise assessment of the proposed LNP site was performed in support of the LNP's Site Certification Application to the State of Florida to estimate overall noise impacts of facility operation and assess compliance with the Levy County Noise Ordinance. As part of this assessment, the sources of noise evaluated included the main plant components, namely the cooling towers and the cooling-system makeup-water pump house located near the CFBC. The closest noise-sensitive receptors were identified as being the residences located approximately 1.6 mi to the northwest and 1.7 mi to the west-southwest of the center of the project site (PEF 2009a).

Modeling of cooling-tower operations predicted noise impacts in the range of 25 to 28 dBA attributable to normal plant operation at these locations. The noise analysis also predicted that offsite noise levels from the cooling towers would not approach or exceed the noise limitations established by the Levy County Noise Ordinance (65 dBA for daytime hours and 55 dBA for nighttime hours in rural and residential areas).

Noise levels in publicly accessible areas from the CWIS makeup-water pump house were also modeled. Noise impacts from the proposed plant and pump house are not expected to be significant at the nearest residences or at the closest recreational areas (Crystal River Preserve State Park and Goethe State Forest) except in the immediate vicinity of the pump house. All estimated noise impacts (even near the pump house) were below Levy County standards (PEF 2009a).

PEF anticipates that four 500-kV transmission lines would service the proposed LNP (PEF 2009a). For 500-kV transmission lines, corona noise, when present, is typically below ambient outdoor levels. During rain showers, the corona noise likely would not be readily distinguishable from background noise. During very moist but not rainy conditions, such as heavy fog, the resulting small increase in the background noise levels would not be expected to result in annoyance to adjacent residents. Periodic maintenance activities, particularly vegetation management, would produce noise from mowing, bush-hogging, and tree and limb trimming and grinding (PEF 2009a).

As discussed in Section 4.8.2, noise levels below 60 to 65 dBA are considered to be of small significance (NRC 1996, 2002). Based on the relatively low levels of noise associated with the operation of the proposed LNP Units 1 and 2 and transmission lines, the significant attenuation of that noise, and that the postulated noise levels from the cooling towers and CWIS intake pump house are all in compliance with the Levy County Noise Ordinance, the review team concludes that potential noise impacts associated with the operation of the new units on the public would be minor and would not require mitigation.

5.8.3 Acute Effects of Electromagnetic Fields

In its ER, PEF states that four 500-kV transmission lines would service the proposed LNP (PEF 2009a). Electric shock resulting from either direct access to energized conductors or induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1996). PEF has evaluated electric shock potential of template 500-kV lines built to present National Electric Safety Code (NESC) standards. Three scenarios involving different vehicle sizes were evaluated to determine maximum induced current as a function of distance from different types of transmission-tower/line configurations. The results of the calculations are used to assure that the transmission lines, as installed, would comply with the 5-mA standard in the present NESC (PEF 2009a).

The transmission lines would also be designed to comply with the FDEP regulations (Fla. Admin. Code Rule 62-814.450(3)) limiting maximum electrical and magnetic field strength (FDEP 2010):

- The maximum electric field at the edge of the transmission-line corridor and at the new substation property boundary shall not exceed 2 kV/m.
- The maximum electric field on the transmission-line corridor shall not exceed 10 kV/m.
- The maximum magnetic field at the edge of the transmission-line right-of-way and at the new substation property boundary shall not exceed 200 milliGauss (mG).

Based on PEF's commitment to design new transmission lines to ensure that the present NESC criteria are met for all of the anticipated transmission-line configurations for the proposed LNP, the staff concludes that the impact on the public from acute effects of EMFs would be minimal, and additional mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce an EMF of nonionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF) EMF. Research on the potential for chronic effects of EMF from energized transmission lines was reviewed and addressed by the NRC in NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). An NIEHS report (NIEHS 1999) contains the following conclusion:

> "The NIEHS concludes that ELF-EMF 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 a 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."

The review team reviewed available scientific literature on chronic effects on human health from ELF-EMF published since the NIEHS report and found that several other organizations reached the same conclusions (AGNIR 2006; WHO 2007). Additional work under the auspices of the World Health Organization (WHO) updated the assessments of a number of scientific groups reflecting the potential for transmission-line EMF to cause adverse health impacts in humans.

In the report by WHO, the authors summarized the potential for ELF-EMF to cause diseases, such as cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, and neurological disease. The results of the review by WHO found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive (WHO 2007).

The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts.

5.8.5 Occupational Health

As discussed in Section 2.10, human health risks for personnel engaged in activities such as maintenance, testing, and plant modifications for LNP Units 1 and 2 are expected to be dominated by occupational accidents (e.g., falls, electric shock, or burns) or occupational illnesses due to noise exposure, exposure to toxic or oxygen-replacing gases, and other hazards. The 2008 annual incidence rate (the number of injuries and illnesses per 100 full-time workers) for electric power generation, transmission, and distribution workers in the United States was 3.2 (BLS 2010). The 2008 national annual illness and injury rate for nuclear electric power generation workers was 0.7 (BLS 2010). Assuming a total operations workforce of 773 (PEF 2009a), this suggests that operation of LNP Units 1 and 2 would be associated with approximately 5 occupational injuries and illnesses per year. However, as was the case for construction injury estimates in Section 4.8, these are gross estimates that do not take into account injury risks that workers would face if they were employed somewhere other than the LNP. The net effect of LNP operation on total occupational injuries in Levy County could be considerably lower, or even negative, if alternative employment is associated with higher risks.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards (29 CFR Part 1910), practices, and procedures. These safe work practices address a number of occupational health issues (e.g., hearing protection; confined space entry; personal protective equipment; heat stress; electrical safety; the safe use of ladders; chemical handling, storage, and use; and other industrial hazards). PEF states that it will adhere to NRC, OSHA, and State safety standards, practices, and procedures during new nuclear unit operations (FDEP 2010).

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. PEF indicates that (1) workers potentially exposed to thermophilic organisms during maintenance activities would use respiratory protection (PEF 2008a), and (2) it would comply with applicable Federal standards and with its own internal corporate procedures to ensure proper management of hazardous wastes and assure worker safety (PEF 2008a).

Based on mitigation measures identified by PEF in its ER; strict adherence to NRC and OSHA safety standards, practices, and procedures; and the review team's independent evaluation, the review team concludes that occupational health impacts on LNP onsite personnel would be minimal, and no further mitigation would be warranted.

5.8.6 Impacts of Transporting Operations Personnel to and from the Proposed Site

This EIS assesses the impact of transporting workers to and from the LNP site from the perspective of three areas of impact: (1) the socioeconomic impacts, (2) the air quality impacts of fugitive dust and particulate matter emitted by vehicle traffic, and (3) the potential health impacts related to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 5.4.1.3, and air quality impacts are addressed in Section 5.7.1.

The general approach used to calculate the nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the proposed LNP site (see Section 4.8.3 of this EIS). However, preliminary estimates are the only data available to estimate these impacts. The impacts evaluated in this section for two new nuclear generating units at the LNP site are appropriate to characterize the alternative sites discussed in Section 9.3 of this EIS. Alternative sites evaluated in this EIS include Crystal River in Citrus County, Dixie in Dixie County, Highlands in Highlands and Glades counties, and Putnam in Putnam County. There is no meaningful differentiation among the proposed and alternative sites regarding the nonradiological environmental impacts from transporting operations and outage personnel to the LNP site and alternative sites, and these issues are not discussed further in Chapter 9.

The assumptions made by the review team to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are listed below.

- The total number of workers estimated for operation of the proposed LNP site was estimated to be 800 for two Westinghouse AP1000 pressurized water reactor units (Kimley-Horn 2009). An additional 800 temporary workers are estimated to be needed for refueling outages (Kimley-Horn 2009), which would occur at 18-month intervals for each AP1000 unit. The staff assumed that outages for the two units would not occur simultaneously. However, the staff assumed that two outages could occur during the same year.
- The average commuting distance for operations and outage workers was conservatively assumed by the review team to be 20 mi one way, based on U.S. Department of Transportation (DOT) data that estimates that the typical commute is 16 mi (DOT 2003).

- To develop representative commuter traffic impacts, data from the Florida Department of Highway Safety and Motor Vehicles provides Florida-specific accident, injury, and fatality rates for the years 2003 to 2007 (FLHSMV 2007).

The estimated impacts of transporting operations and outage workers to and from the proposed LNP site and alternative sites are listed in Table 5-8. The total annual traffic fatalities during operations, including both operations and outage personnel, represent about a 0.6 percent increase above the average 17 traffic fatalities per year that occurred in Levy County, Florida, from 2003 to 2007 (FLHSMV 2007). The impacts of transporting operations and outage workers to and from the alternatives sites were about a 0.4 percent increase for the Crystal River site in Citrus County, a 1-percent increase for the Dixie site in Dixie County, a 0.5- to 2-percent increase for the Highland site in Highland and Glades Counties, and a 0.5 percent increase for the Putnam site in Putnam County. These percentages represent negligible increases relative to the current traffic fatality risks in the areas surrounding the proposed LNP site and alternative sites.

Table 5-8. Nonradiological Impacts of Transporting Workers to and from the Proposed LNP Site for Two Reactors

	Accidents Per Year	Injuries Per Year	Fatalities Per Year
Permanent workers	6.8×10^{0}	5.9×10^{0}	8.8×10^{-2}
Outage workers	1.6×10^{0}	1.4×10^{0}	2.1×10^{-2}

Based on the information provided by PEF, the review team's independent evaluation, and considering this increase would be negligible relative to the current traffic fatalities (i.e., before the proposed units are constructed) in the affected counties, the review team concludes that the nonradiological impacts of transporting operations and outage workers to the proposed LNP site and alternative sites would be minimal, and mitigation would not be warranted.

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts on the public and workers from the proposed cooling system, noise generated by plant operations, acute and chronic impacts of EMFs, and transporting operations and outage workers to and from the proposed LNP Units 1 and 2. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts on the public and workers from etiological agents, noise generated by plant operations, and acute impacts of EMF would be minimal. The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the potential impacts on nonradiological health resulting from the operation of the proposed LNP Units 1 and 2 would be SMALL, and mitigation would not be warranted.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of proposed LNP Units 1 and 2, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the LNP site. Estimated doses to workers at Units 1 and 2 are also discussed. Radiological impacts were determined using the Westinghouse AP1000 reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation (see discussion in Section 3.2.1).

Revision 15 of the AP1000 design (Westinghouse 2005) is a certified design as set forth in 10 CFR Part 52, Appendix D. Subsequently, Westinghouse submitted Revisions 16 and 17 of the AP1000 design. Revision 1 of the PEF ER incorporates Revision 17 of the Design Control Document (DCD). Therefore, the COL application and evaluation of radiological impacts of normal operations presented here are based on Revision 17 of the DCD (Westinghouse 2008).

5.9.1 Exposure Pathways

The public and biota would receive radiation dose from a nuclear unit via the liquid effluent, gaseous effluent, and direct radiation pathways. PEF estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the LNP site. PEF considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (PEF 2009a). For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, the ER considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., fish and invertebrates), direct radiation exposure from shoreline activities, and swimming and boating exposure. The analysis for population dose considered the following exposure pathways: ingestion of aquatic food and direct radiation exposure from shoreline activities, swimming, and boating. PEF plans to release liquid effluents into the Gulf of Mexico at the end of the CREC Unit 3 discharge canal. The MEI and the population within 50 mi of the proposed LNP Units 1 and 2 do not consume drinking water from the Gulf of Mexico; therefore, doses associated with the drinking water pathway were not evaluated (PEF 2009a).

For the gaseous effluent release pathway, PEF considered the following exposure pathways in evaluating the dose to the MEI: immersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, and ingestion of beef. PEF (2009a) calculated a dose from goat milk but not cow milk ingestion because the most recent land-use census indicated that no milk cows existed within 5 mi of the site.

For population doses from the gaseous effluents, PEF (2009a) used the same exposure pathways used for the individual dose assessment – with the addition of the cow milk ingestion pathway. All agricultural products grown within 50 mi of LNP Units 1 and 2 were assumed to be consumed by the population dose within 50 mi of the proposed LNP site (see Figure 5-9).

PEF (2009a) states that direct radiation from the reactor buildings would be the primary sources of direct radiation exposure to the public from the LNP site. However, PEF assumes that contained sources of radiation at the LNP site would be shielded and provide a negligible contribution to the external dose of the MEI or the population. The assumption of negligible contribution from direct radiation beyond the site boundary is supported by the DCD (Westinghouse 2008). The direct radiation from the containment and other plant buildings would be negligible. The AP1000 design also provides for the storage of refueling water inside the containment building instead of in an outside storage tank; that eliminates it as a radiation source. The NRC staff concurs that the doses from direct radiation at the site boundary would be negligible.

Exposure pathways considered in evaluating dose to biota are shown in Figure 5-10 and include the following:

- ingestion of aquatic foods
- ingestion of water
- external exposure from water immersion and shoreline sediments
- inhalation of airborne radionuclides
- external exposure to immersion in gaseous effluent plumes
- surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977).

The NRC staff reviewed the exposure pathways for the public and non-human biota identified by PEF and found them to be appropriate, based on a documentation review and a tour of the environs with PEF staff and contractors during the site visit in December 2008.

5.9.2 Radiation Doses to Members of the Public

PEF calculated the dose to the MEI and the population living within a 50-mi radius of the site from both the liquid and gaseous effluent release pathways (PEF 2009a). As discussed in Section 5.9.1, direct radiation exposure to the MEI from sources of radiation at the LNP Units 1 and 2 would be negligible.

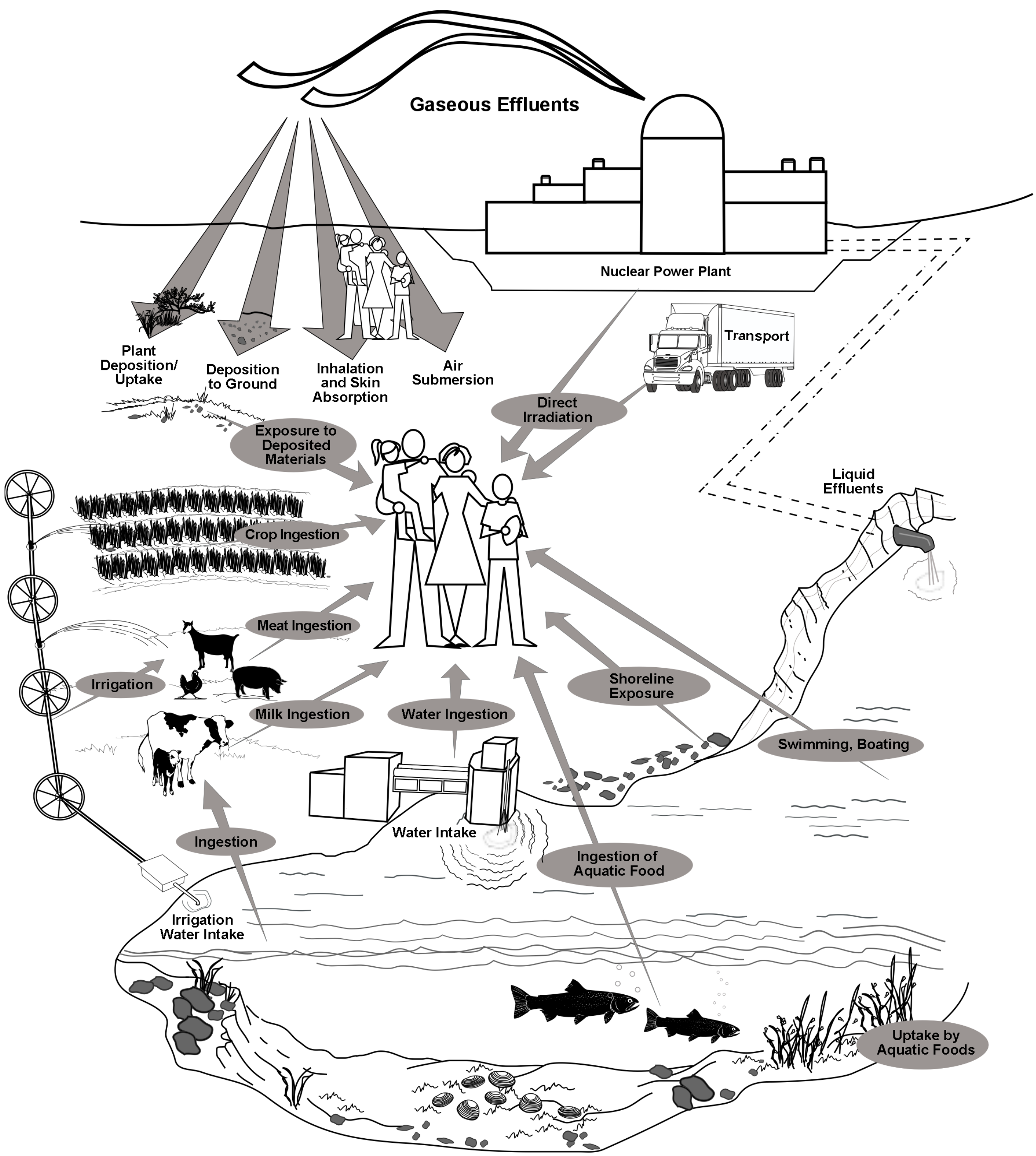

Figure 5-9. Exposure Pathways to Man (adapted from Soldat et al. 1974)

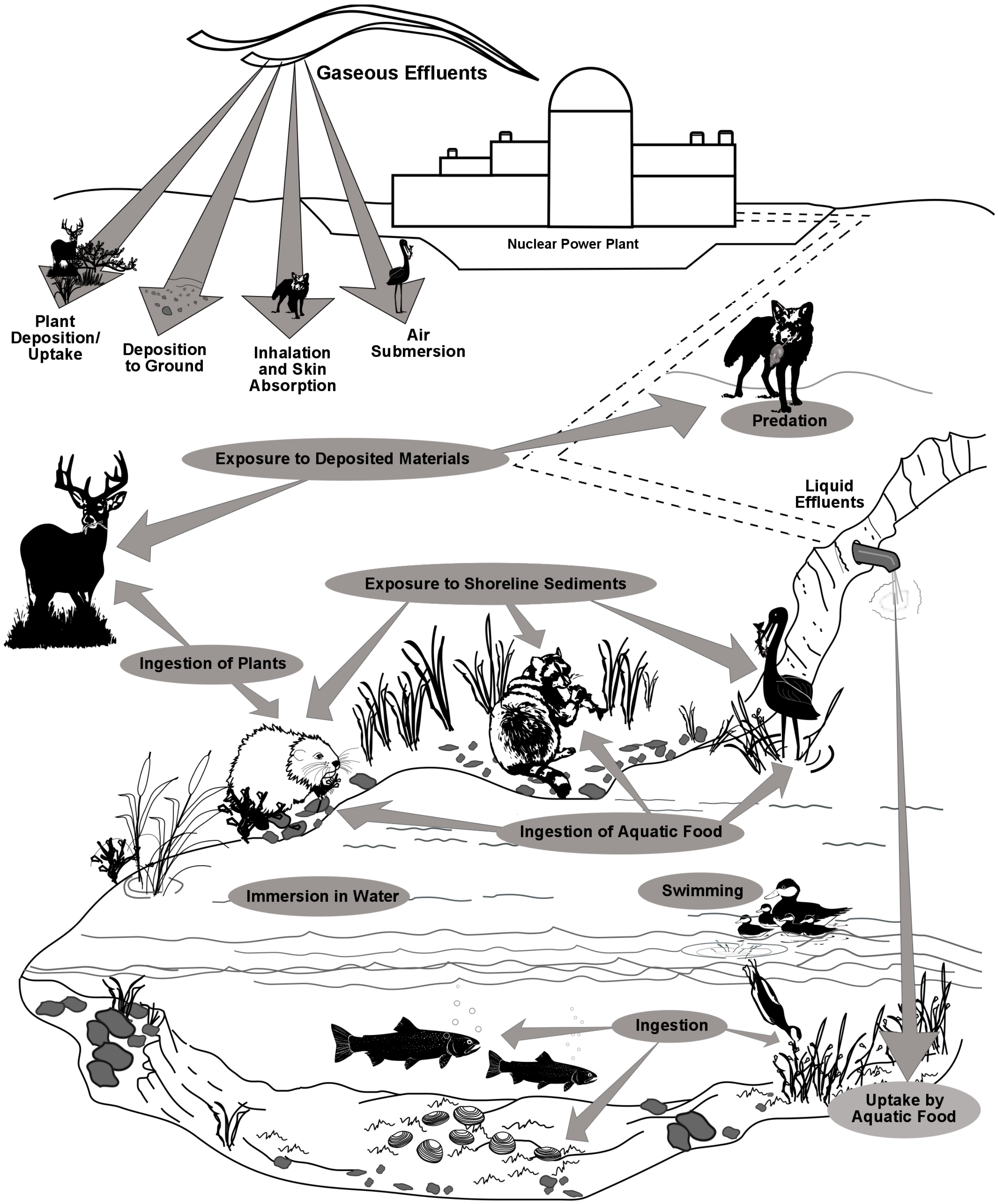

Figure 5-10. Exposure Pathways to Biota Other Than Man (adapted from Soldat et al. 1974)

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986). Fish consumption and recreational usage were considered in the PEF dose calculations (PEF 2009a).

The liquid effluent releases used in the estimates of dose are found in Table 5.4-1 of the ER (PEF 2009a). Other parameters used as inputs to the LADTAP II program, including liquid pathway consumption and usage factors (i.e., fish consumption and recreational usage), are found in Tables 5.4-1 and 5.4-2 of the ER (PEF 2009a). PEF calculated liquid pathway doses to the MEI as shown in Table 5-9.

Table 5-9. Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from a New Unit

Pathway	Age Group/ MEI	Total Body (mrem/yr)	Maximum Organ (GI-LLI)[(a)] (mrem/yr)	Thyroid (mrem/yr)
Fish	Adult	0.0027	0.0089	0.0056
	Teen	0.0018	0.0064	0.0051
	Child	0.0012	0.0026	0.0052
Invertebrate	Adult	0.0013	0.062	0.0058
	Teen	0.0012	0.049	0.0054
	Child	0.0012	0.021	0.0058
Shoreline	Adult	0.00039	0.00039	0.00039
	Teen	0.0022	0.0022	0.0022
	Child	0.00045	0.00045	0.00045
Swimming	Adult	0.0000019	0.0000019	0.0000019
	Teen	0.000010	0.000010	0.000010
	Child	0.0000022	0.0000022	0.0000022
Boating	Adult	0.0000079	0.0000079	0.0000079
	Teen	0.0000053	0.0000053	0.0000053
	Child	0.0000011	0.0000011	0.0000011

Source: LADTAP II Output File (PEF 2009i)
(a) GI-LLI is the gastrointestinal tract-lower large intestine.

The staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the MEI for liquid effluent releases. The staff concluded that all of the input parameters used in the PEF calculation were appropriate. The staff performed an independent evaluation of liquid pathway doses using input parameters from the ER and found similar results. The results of the staff's independent evaluation are found in Appendix J.

5.9.2.2 Gaseous Effluent Pathway

PEF calculated gaseous pathway doses to the MEI using the GASPAR II computer program (Strenge et al. 1987) at the nearest residence, the exclusion area boundary, the nearest garden, milk goat, and meat cow. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating contaminated grass, and (4) ingestion of garden vegetables contaminated by gases and particulates. PEF (2009a) indicates that milk goats, but not milk cows, are located within 5 mi of the proposed site. PEF calculated MEI doses for the goat milk pathway; but PEF included cow milk pathway for the calculation of population dose. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 11.3-3 of the Westinghouse AP1000 DCD Revision 17 (Westinghouse 2008). Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground-deposition factors, receptor locations, and consumption factors, are found in Tables 5.4-3 and 5.4-4 of the ER (PEF 2009a). PEF calculated the MEI dose by combining the plume, ground, and inhalation pathways at the nearest residence with the milk goat, meat, and vegetable garden ingestion pathways at the locations with the highest doses. The goat-milk pathway provides a higher dose than the cow-milk pathway at any given location and therefore is more conservative for this analysis. Gaseous pathway doses for a single unit are shown in Table 5-10.

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff reviewed the input parameters and values used by PEF and concluded that the parameters used by PEF were appropriate. The NRC confirmed the dose calculations using the information contained in the ER. The staff performed an independent evaluation of gaseous pathway doses and obtained similar results for the MEI. The NRC staff's evaluation is presented in Appendix J.

5.9.3 Impacts on Members of the Public

This section describes the staff's evaluation of the estimated impacts from radiological releases and direct radiation of the proposed two new units at the LNP site. The evaluation addresses dose from operations to the MEI located at the LNP site and the population dose (collective dose to the population within 50 mi) around the LNP site.

Table 5-10. Annual Individual Doses to the Maximally Exposed Individual from Gaseous Effluents for a New Unit

Pathway	Age Group	Total Body Dose[(a)] (mrem/yr)	Max Organ (Bone) (mrem/yr)	Skin Dose[(b)] (mrem/yr)	Thyroid Dose[(a)] (mrem/yr)
Plume (0.83 mi west-southwest [WSW])	All	0.985	0.985	6.32	0.985
Ground (0.83 mi WSW)	All	0.114	0.114	0.133	0.114
Goat Milk (2.4 mi north-northwest)	Adult	0.0253	0.0770	NA	0.155
	Teen	0.0404	0.141	NA	0.246
	Child	0.0867	0.347	NA	0.497
	Infant	0.170	0.673	NA	1.17
Inhalation (0.83 mi WSW)	Adult	0.0598	0.00863	NA	0.521
	Teen	0.0605	0.0104	NA	0.649
	Child	0.0536	0.0127	NA	0.753
	Infant	0.0309	0.00637	NA	0.673
Vegetable (1.7 mi WSW)	Adult	0.530	2.08	NA	1.43
	Teen	0.804	3.40	NA	1.98
	Child[(c)]	1.80	8.16	NA	4.05
Meat (2.8 mi south-southwest)	Adult	0.0128	0.0564	NA	0.0180
	Teen	0.0104	0.0476	NA	0.0142
	Child[(c)]	0.0189	0.08741	NA	0.0246

Source: PEF 2009a.
(a) See PEF ER Table 5.4-7 Gaseous Pathways – Dose Summary Maximum Exposed Individuals for one AP1000 Unit
(b) Skin dose is applicable for plume and ground and not for inhalation, vegetable, milk, and meat pathways.
(c) Infant doses are not calculated for the vegetable or meat pathways because the doses that infants receive from this diet would be bounded by the dose calculated for the child.
NA = not applicable.

5.9.3.1 Maximally Exposed Individual

PEF (2009a) states that total body and organ dose estimates to the MEI from liquid and gaseous effluents for each new unit would be within the dose design objectives of 10 CFR Part 50, Appendix I. Liquid effluents released to the Gulf of Mexico would result in doses to the MEI (total body and maximum organ) that would be well within the respective 3-mrem/yr and 10-mrem/yr Appendix I dose design objectives. Doses at the exclusion area boundary from gaseous effluents would be well within the Appendix I dose design objectives of a 10-mrad/yr air dose from gamma radiation, a 20-mrad/yr air dose from beta radiation, a 5-mrem/yr dose to the total body, and a 15-mrem/yr dose to the skin. In addition, dose to the thyroid would be within the 15-mrem/yr Appendix I dose design objective. A comparison of dose estimates for each new unit to the Appendix I dose design objectives is found in Table 5-11. The staff completed an independent evaluation of compliance with Appendix I dose design objectives and obtained similar results. The staff's evaluation is presented in Appendix J.

Table 5-11. Comparisons of MEI Dose Estimates from Liquid and Gaseous Effluent for a Single New Nuclear Unit to 10 CFR Part 50, Appendix I Dose Design Objectives

Pathway/Type of Dose	PEF (2009a)	Appendix I Design Objectives
Liquid Effluents		
Total Body	0.0052 mrem (Teen – all pathways)	3 mrem
Maximum Organ Dose	0.071 mrem (Adult – GI-LLI)	10 mrem
Gaseous Effluent (Noble Gases Only)		
Gamma Air Dose	1.7 mrad	10 mrad
Beta Air Dose	9.9 mrad	20 mrad
Total Body Dose	3.1 mrem	5 mrem
Skin Dose	6.3 mrem	15 mrem
Gaseous Effluents (Radioiodines and Particulates)		
Maximum Organ Dose	9.7 mrem (Child – bone)	15 mrem

Source: PEF 2009a.
GI-LLI = gastrointestinal tract-lower large intestine.

Table 5-12 presents the comparison of doses for LNP Units 1 and 2 with the dose standards of 40 CFR Part 190. The table shows PEF's assessment of total doses to the MEI from LNP liquid and gaseous effluents. PEF's assessment of doses includes releases of radiation from CREC Unit 3 because LNP shares a common discharge point for liquid releases with the CREC Unit 3. In addition, although the LNP and CREC sites are separated by nearly 10 mi, PEF added the gaseous effluent doses for CREC to the gaseous effluent doses for LNP to provide a bounding assessment for LNP. As stated in Section 5.9.1, the direct radiation doses from LNP Units 1 and 2 at the site boundary would be negligible. PEF's assessment shows that the 40 CFR Part 190 standards would be met. The NRC staff completed an independent evaluation of compliance with 40 CFR Part 190 standards and obtained similar results. The NRC staff's evaluation is presented in Appendix J.

Table 5-12. Comparison of Maximally Exposed Individual Dose Rates with 40 CFR Part 190 Criteria (mrem/yr)

	CREC Total Liquid and Gaseous Dose[(a)]	LNP Units 1 and 2[(b)]			40 CFR 190 Dose Standards
		Liquid	Gaseous	Total	
Total Body	0.00008	0.021	5.5	5.5	25
Thyroid	0.002	0.025	12.8	12.9	75
Other Organ – Bone	0.002	0.14	19.4	19.5	25

Source: PEF 2009a.
(a) CREC operating data.
(b) Calculated LNP Units 1 and 2 doses.

5.9.3.2 Population Dose

PEF estimated the collective total body dose within a 50-mi radius of the proposed LNP site for gaseous and liquid pathways to be 5.74 and 1.13 person-rem/yr per unit, respectively (PEF 2009a). Collective population doses from the gaseous and liquid effluent pathways were estimated by PEF using the GASPAR II and LADTAP II computer codes, respectively. The NRC staff performed an independent evaluation of population doses and obtained similar results (see Appendix J).

The estimated collective dose to the same population from background radiation is 520,000 person-rem/yr (PEF 2009a). The dose from natural background radiation was calculated by multiplying the 50-mi population projected to 2020 of approximately 1.44 million by the annual background dose rate of 360 mrem/yr. A recent National Council on Radiological Protection and Measurements (NCRP) publication (NCRP 2009) estimates a background dose rate of 311 mrem/yr. Using this dose rate, the NRC staff estimate of dose from natural background radiation is 450,000 person-rem/yr.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from

International Commission on Radiation Protection (ICRP) Publication 103 (ICRP 2007). The estimated collective total body dose to the population living within 50 mi of the proposed LNP site is 6.9 person-rem/yr per unit, which is less than the 1754 person-rem/yr value that ICRP and NCRP suggest would most likely result in zero excess health effects (ICRP 2007; NCRP 1995).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found “no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities” (Jablon et al. 1990).

5.9.3.3 Summary of Radiological Impacts on Members of the Public

The NRC staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from proposed new units at the LNP site. Based on the information provided by PEF and NRC’s independent evaluation, the NRC staff concludes there would be no observable health impacts on the public from normal operation of the proposed new units, the health impacts would be SMALL, and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

Radiation exposures in an AP1000 type plant would be primarily due to direct radiation from components and equipment containing radioactive material. In addition, in some areas of the plant there would be radiation exposure to personnel due to the presence of airborne radionuclides. In Section 12.4 of the AP1000 DCD, the annual occupational dose is estimated to be 67.1 person-rem/yr per unit for normal operation and anticipated inspection and maintenance activities (Westinghouse 2008). This collective dose is based on an 18-month fuel cycle and would be bounding for a 24-month fuel cycle.

The licensee of a new plant would need to maintain individual doses to workers within 5 rem annually as specified in 10 CFR 20.1201 and to incorporate provisions to maintain doses as low as reasonably achievable (ALARA).

The NRC staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within the limits of 10 CFR 20.1201 and collective occupational doses being typical of doses found in current operating LWR reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Impacts on Non-Human Biota

PEF estimated doses to biota species in the LNP site environs, in many cases using surrogate species. Surrogate species used in the ER are well-defined and provide an acceptable method for evaluating doses to biota. Surrogate species analysis was performed for aquatic species, such as fish, invertebrates, and algae, and for terrestrial species, such as muskrats, raccoons, herons, and ducks.

PEF calculated doses to important aquatic and terrestrial biota species in addition to surrogate species. Important biota species for the LNP site are as follows: various mussel and mollusk species; grouper (red, black, and gag), spotted sea trout, flounder, and sturgeon; white-tailed deer and Florida black bear; wild turkey, wood duck, bald eagle, northern bobwhite, red-cockaded woodpecker, and wood stork. The important biota species with the highest calculated dose was the northern bobwhite.

Exposure pathways considered in evaluating dose to biota are discussed in Section 5.9.1 and shown in Figure 5-10. The NRC staff reviewed PEF's calculations (PEF 2009a) and performed an independent evaluation with results similar to those reported by PEF (2009a).

5.9.5.1 Liquid Effluent Pathway

PEF used the LADTAP II computer code to calculate doses to biota from the liquid effluent pathway. Liquid pathway doses are higher for biota compared to humans because of considerations of bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in the water and at the shoreline compared to humans. Proposed LNP Units 1 and 2 blowdown and liquid releases would flow into the discharge canal that serves CREC Unit 3. Parameters used in the PEF analysis are found in Tables 3.3-2, 5.5-1 and 5.4-14 of the ER. Table 5-13 presents the PEF estimates of liquid effluent pathway doses to biota from proposed LNP Units 1 and 2. The staff performed an independent analysis (Appendix J) and concludes that all of the input parameters used in the PEF calculation and the resulting doses are appropriate.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. PEF calculated doses to terrestrial species using the methods described in Section 5.9.2 with some modifications. PEF used the results of the GASPAR II computer code to calculate doses to terrestrial biota from gaseous effluent releases with four modifications. The first modification

Table 5-13. Biota Doses for Proposed Units 1 and 2[(a)]

	Doses from Liquid Effluents in Discharge Canal		Doses from Gaseous Effluents	
	LNP 1 and 2		LNP 1 and 2	
	Internal Dose (mrad/yr)	External Dose (mrad/yr)	Internal Dose (mrad/yr)	External Dose (mrad/yr)
Saltwater Fish	0.11	0.57	0.0	0.0
Invertebrate	3.90	1.10	0.0	0.0
Algae	8.80	0.00	0.0	0.0
Muskrat	0.88	0.38	0.0	2.00
Raccoon	0.14	0.28	0.0	2.00
Heron	0.62	0.38	0.0	1.40
Duck	0.83	0.57	0.0	2.00
Northern Bobwhite	0.00	0.00	0.014	18.0

Source: PEF 2009a.
(a) Radiological doses to non-human biota are expressed in units of absorbed dose (rad).

was to adjust the doses for residence time; the second was to increase the external dose from ground deposition by a factor of two to account for closer proximity to the ground; third, the gamma energy absorption rate in air was used; and fourth, the beta energy absorption rate in air was reduced by a factor of 2. Parameters used in the PEF analysis are found in Tables 3.5-5, 5.5-1, and 5.4-14 of the ER. Table 5-13 presents the PEF estimates of gaseous effluent pathway doses to biota from the proposed LNP Units 1 and 2. The staff performed an independent analysis (Appendix J) and concludes that all of the input parameters used in the PEF calculation and the resulting doses are appropriate.

5.9.5.3 Impact of Estimated Biota Doses

The International Atomic Energy Agency (IAEA 1992) and the NCRP (1991) reported that a chronic dose rate of no greater than 10 mGy/d (1000 mrad/d) to the MEI in a population of aquatic organisms would ensure protection of the population. IAEA (1992) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations.

Table 5-14 compares estimated total body dose rates to surrogate biota species produced by releases from LNP Units 1 and 2 to the IAEA/NCRP biota dose guidelines (IAEA 1992, NCRP 1991). The maximum total dose from liquid and gaseous pathways from the bounding calculation is about 0.5 mrad/d. Thus, the doses to biota calculated by PEF are far below the 100-mrad/d IAEA guideline (IAEA 1992) for terrestrial biota and the 1000-mrad/d guideline for aquatic biota. Based on the information provided by PEF and the NRC staff's independent evaluation, the NRC staff concludes that the radiological impact on biota from the routine operation of the proposed LNP Units 1 and 2 would be SMALL, and additional mitigation would not be warranted.

Table 5-14. Comparison of Biota Doses from the Proposed LNP Units 1 and 2 to IAEA Guidelines for Biota Protection

Biota	PEF Estimate of Dose to Biota (mrad/d)[(a)]	IAEA/NCRP Guidelines for Protection of Biota Populations (mrad/d)[(b)]
Fish	0.01	1000
Invertebrate	0.02	1000
Algae	0.03	1000
Muskrat	0.02	100
Raccoon	0.01	100
Heron	0.01	100
Duck	0.02	100
Northern bobwhite	0.5	100

Sources: PEF 2009a, IAEA 1992.
(a) Sum of doses to biotic species is from PEF ER Table 5.4-16.
(b) Guidelines in NCRP and IAEA reports expressed in Gy/d (1 mGy/d equals 100 mrad/d).

5.9.6 Radiological Monitoring

The LNP site is a greenfield site. Therefore, PEF has not established a radiological monitoring program at the site. A preoperational monitoring program would begin 2 years prior to the start of operation of LNP Unit 1, and an operational radiological environmental monitoring program (REMP) would be established prior to the beginning of operation of LNP Unit 1. A REMP has been in place at PEF's CREC Unit 3 site since operations began in 1977. Accordingly, the staff expects that PEF will develop a REMP for the operation of LNP Units 1 and 2 based on information from the CREC Unit 3 program and data collected during the preoperational REMP.

The CREC Unit 3 REMP includes monitoring of the following exposure pathways: airborne, direct, water, aquatic from the Gulf of Mexico, and ingestion within a 5-mi radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi away. Many of the sampling stations used for CREC Unit 3 would also be used for proposed LNP Units 1 and 2 because they would share a common liquid discharge canal. Many of the control or background sampling stations may also be shared. The State of Florida Department of Health, Bureau of Radiation Control (BRC), performs sampling of the facility environs for PEF. The State also performs the required analyses, participates in the Interlaboratory Comparison Program, and performs the annual land-use census. Radiological releases are summarized in an annual radiological environmental operating report produced by BRC and transmitted by PEF to the NRC.

The staff reviewed the CREC Unit 3 annual reports for 2006 and 2007 and consulted with the State's BRC Environmental Administrator during the December 2008 site audit. Observations and trending analysis of past conditions provide a robust and comprehensive program (PEF 2007, 2008d).

The CREC Unit 3 annual reports for 2006 and 2007 show that trace concentrations of CREC Unit 3 effluents enter the intake canal for CREC Unit 3. LNP would share effluent discharge point with CREC Unit 3; therefore, some of the LNP effluents may also enter the CREC Unit 3 intake canal. NRC Regulatory Issue Summary 2008-03 indicates that water containing radioactive material returned from the environment can be used by the licensee and returned to the environment without being considered a new radioactive material effluent released (NRC 2008a). The staff review of these reports found no indication of radiological consequence associated with the operation of CREC Unit 3 that would affect the NRC's conclusion regarding LNP Units 1 and 2.

5.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during operation of the proposed LNP. As discussed in Section 3.4.4, the types of nonradioactive waste that would be generated, handled, and disposed of during operation include municipal solid waste, industrial solid wastes, stormwater runoff, sanitary waste, liquid effluents containing chemicals or biocides, industrial liquid wastes, and combustion emissions. In addition, small quantities of hazardous waste and mixed waste, which is waste that has both hazardous and radioactive characteristics, may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts on Land

The expected nonradioactive waste streams destined for land-based treatment or disposal during operation include water-treatment wastes, laboratory wastes, trash, sanitary waste, cooling-water intake screen debris, and small quantities of hazardous waste.

Nonhazardous solid waste generated during operation would be segregated and recycled to the extent practicable, with the balance disposed of in an offsite, permitted landfill. Debris collected from the CFBC intake structure trash racks and screens would also be disposed of in local landfills. Spent filters from the raw-water system and from the reverse osmosis system for demineralized water treatment would be disposed of in accordance with applicable industrial solid waste regulations. No solid wastes would be burned or disposed of onsite during operations (PEF 2009a). PEF estimates that during operations, the LNP would generate an average of 1617 tons of solid waste annually (PEF 2008a). A licensed sanitation contractor would periodically remove and dispose of the sludge from the sanitary waste-treatment plant (PEF 2008a).

All transportation, storage, and disposal of regulated hazardous wastes would be in accordance with applicable Federal, State, and local requirements. All hazardous wastes would be collected, transported offsite by a licensed and permitted Resource Conservation and Recovery Act (RCRA) waste hauler, and treated or disposed of offsite at a RCRA-permitted facility. Storage of some hazardous materials and associated wastes would occur in the Hazardous Waste Storage Building (Building 136), two Chemical Storage Buildings (Buildings 119 and 120), and the Painting and Sandblast Shop (Building 105) (PEF 2009a, i).

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by the Atomic Energy Act of 1954, the Solid Waste Disposal Act of 1965, as amended by RCRA in 1976, and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). The mixed waste from the LNP would be handled and managed in accordance with the applicable Federal, State, and local requirements. The packaged waste would be stored in the auxiliary and radwaste buildings until it is shipped offsite to a licensed disposal facility (PEF 2009a, i).

Because no wastes would be landfilled onsite and all wastes destined for land-based treatment or disposal would be transported offsite by licensed contractors to existing, licensed, disposal facilities operating in compliance with all applicable Federal, State and local requirements, the review team expects that impacts on land from nonradioactive and mixed wastes generated during operation of the LNP would be minor, and no further mitigation would be warranted.

5.10.2 Impacts on Water

The nonradioactive liquid waste streams during operation would include cooling-water blowdown, auxiliary-boiler blowdown, water-treatment wastes, discharge from floor and equipment drains, stormwater runoff, and effluents from the sanitary sewage-treatment system.

All nonradioactive, liquid discharges during operation would need to comply with the applicable provisions of NPDES Permit No. FL0633275-001-IW1S/NP upon final issuance (FDEP 2010). All of the liquid effluent streams from the LNP would combine into a single stream and be discharged via the CREC discharge canal into the Gulf of Mexico (PEF 2009a).

Because all nonradioactive liquid wastes from the LNP would be combined into a single, permitted, and monitored discharge stream, the review team concludes that impacts on water from nonradioactive liquid wastes generated during operation of the LNP would be minimal, and no further mitigation would be warranted.

5.10.3 Impacts on Air

The nonradioactive gaseous waste streams during operation would include emissions from the combustion of fossil fuels, volatile emissions from those fuels, and other volatile organic compounds (VOCs) from the use of materials such as paints, oils, and solvents.

Gaseous emissions would be produced by the combustion of diesel fuel during monthly testing of the 10 diesel engines that would power fire-water pumps and standby generators. Each of these diesel engines would have an associated fuel tank that would release small quantities of VOCs. Additional VOCs would be released from the use of paints, oils, solvents, and other standard building and maintenance materials.

PEF also plans to construct and operate a fueling station in the motor pool area but details are not yet available on the size of the station, the number and types of fuel tanks, or the makeup of the vehicle fleet to be serviced by the station (PEF 2009i). Any emissions from the fueling station would be offset by a reduction in emissions from offsite service stations, at which the LNP vehicle fleet would need to be refueled in the absence of an onsite service station.

Nonradioactive gaseous emissions from operations (including greenhouse gas emissions) would be limited in magnitude. PEF would install equipment with appropriate emission controls and comply with all applicable Federal, State and local requirements. Based on the above analysis, the NRC staff concludes that impacts on air from nonradioactive gaseous wastes generated during operation of the LNP facility would be minimal, and mitigation would not be warranted.

5.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, gaseous, hazardous, and mixed wastes generated during operation of proposed LNP Units 1 and 2 would be handled according to county, State, and Federal regulations. County and State permits for handling and disposal of solid waste would be obtained and implemented. Compliance with the NPDES permit for releases of cooling water and other liquid effluents would ensure compliance with the Federal Water Pollution Control Act (Clean Water Act) and Florida water-quality standards. Air emissions from the LNP would be minimal and would not reduce the local air quality. All transportation, storage, and disposal of regulated hazardous and mixed wastes would be in accordance with applicable Federal, State, and local requirements.

Based on the information provided by PEF, the planned practices for recycling, minimizing, managing, and disposing of wastes, the requirements to obtain regulatory approvals for waste disposal and discharges, and the review team's independent evaluation, the review team concludes that the potential impacts from nonradioactive and mixed waste resulting from the operation of the proposed LNP facility would be SMALL, and mitigation would not be warranted.

5.11 Environmental Impacts of Postulated Accidents

The staff considered the radiological consequences on the environment of potential accidents at the LNP site. PEF based its COL application on the proposed installation of AP1000 reactors for Units 1 and 2. Revision 15 of the AP1000 design (Westinghouse 2005) is a certified design as set forth in 10 CFR Part 52, Appendix D. Subsequently, Westinghouse submitted Revision 17 of the AP1000 design (Westinghouse 2008). The PEF application (PEF 2009b) references Revision 17 of the AP1000 DCD. The NRC staff is reviewing the Westinghouse application to amend the design-certification rule for the AP1000.

The term “accident,” as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases that are substantially in greater than permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from nuclear plants. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50, Appendix I. Additional measures are designed to mitigate the consequences of failures in the first line of defense. These include NRC’s reactor site criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident; emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47; 10 CFR Part 50, Appendix E; and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. Most of the material in the fuel is in the form of nonvolatile solids. However, a significant amount of material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in water, (2) inhalation of radioactive material, and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rem over a short period of time (hours). Untreated doses of about 250 to 500 rem received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

PEF evaluated the potential consequences of postulated accidents to demonstrate that an AP1000 reactor could be constructed and operated at the LNP site without undue risk to the health and safety of the public (PEF 2009a). These evaluations used a set of surrogate DBAs that are representative of the reactor design being considered for the LNP site and site-specific meteorological data. The set of accidents covers events that range from a relatively high probability of occurrence with relatively low consequences to a relatively low probability with high consequences.

The DBA review focuses on the AP1000 reactor at the LNP site. The bases for analyses of postulated accidents for this design are well established, because they have been considered as part of NRC's advanced reactor design-certification process. Potential consequences of DBAs are evaluated by following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the AP1000 reactor and methods for evaluating potential accidents are based on guidance provided in Regulatory Guide 1.183 (NRC 2000b).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as relative concentration (χ/Q; units of s/m^3). Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

Table 5-15 lists χ/Q values that the NRC staff considers pertinent to the environmental review of DBAs for the LNP site. Small χ/Q values are associated with greater dilution capability. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary (EAB), the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term period (i.e., 2 hours), and for the low-population zone (LPZ), they are calculated for the course of the accident (i.e., 30 days composed of four time periods). The second column lists the χ/Q values for the LNP site; these values are presented calculated at the EAB and LPZ boundary defined in the PEF Final Safety Analysis Report (PEF 2009b) using 2 years of meteorological data for the LNP site (February 1, 2007 through January 31, 2009).

As discussed in Section 2.9.3.1, the NRC staff reviewed the meteorological data used by PEF and the χ/Q values in the PEF ER. Based on these reviews, the NRC staff concluded that the atmospheric dispersion factors for the LNP site in the ER did not appropriately reflect the realistic dispersion conditions needed for use in evaluating potential environmental consequences of postulated DBAs for the AP1000 reactor design at the LNP site because they were too conservative. Consequently, the χ/Q values in Table 5-15, which are more realistic, were estimated by the NRC staff using the LNP meteorological data.

Table 5-15. Atmospheric Dispersion Factors for the LNP Site DBA Calculations

Time Period and Boundary/Zone	χ/Q (s/m^3)
0 to 2 hr, exclusion area boundary	3.60×10^{-5}
0 to 8 hr, low-population zone	6.04×10^{-6}
8 to 24 hr, low-population zone	4.74×10^{-6}
1 to 4 d, low-population zone	3.75×10^{-6}
4 to 30 d, low-population zone	2.81×10^{-6}

Table 5-16 lists the set of DBAs considered by PEF and presents the estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE) calculated by the NRC staff using the χ/Q values from Table 5-15. TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the effective dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the effective dose equivalent.

Table 5-16. DBA Doses for an AP1000 Reactor for LNP Units 1 and 2

		TEDE (rem)[a]		
Accident	**Standard Review Plan Section[b]**	**EAB[c]**	**LPZ[d]**	**Review Criterion**
Main steam line break	15.1.5			
Preexisting iodine spike		3.60×10^{-2}	1.09×10^{-2}	2.5×10^{1}[e]
Accident-initiated iodine spike		3.96×10^{-2}	3.17×10^{-2}	2.5×10^{0}[f]
Steam generator rupture	15.6.3			
Preexisting iodine spike		7.92×10^{-2}	1.52×10^{-2}	2.5×10^{1}[e]
Accident-initiated iodine spike		3.96×10^{-2}	1.02×10^{-2}	2.5×10^{0}[f]
Loss-of-coolant accident	15.6.5	1.74×10^{0}	6.49×10^{-1}	2.5×10^{1}[e]
Rod ejection	15.4.8	1.30×10^{-1}	7.00×10^{-2}	6.25×10^{0}[f]
Reactor coolant pump rotor seizure (locked rotor)	15.3.3			
Without feedwater		2.88×10^{-2}	4.70×10^{-3}	2.5×10^{0}[f]
With feedwater		2.16×10^{-2}	9.60×10^{-3}	2.5×10^{0}[f]
Failure of small lines carrying primary coolant outside containment	15.6.2	7.56×10^{-2}	1.23×10^{-2}	2.5×10^{0}[f]
Fuel handling	15.7.4	1.87×10^{-1}	3.13×10^{-2}	6.25×10^{0}[f]

(a) To convert rem to Sv, divide by 100.
(b) NUREG-0800 (NRC 2007).
(c) EAB = exclusion area boundary.
(d) LPZ = low-population zone.
(e) 10 CFR 52.79 (a)(1) and 10 CFR 100.21 criteria.
(f) Standard Review Plan 15.0.3 criterion.

The NRC staff reviewed the PEF selection of DBAs by comparing the accidents listed in the PEF DBA analysis with the DBAs considered in Revision 17 of the AP1000 DCD, which is currently in the design-certification process (Westinghouse 2008). The DBAs in the analysis are the same as those considered in design certification, therefore the staff concludes that the set of DBAs is appropriate.

The review criteria used in the staff's safety review of DBA doses are included in Table 5-16 to illustrate the magnitude of the calculated environmental consequences (TEDE doses) because there are no environmental criteria related to the potential consequences of DBAs. In all cases, the calculated TEDE values are considerably smaller than the TEDE doses used as safety review criteria; therefore, the NRC staff concludes that, with respect to DBAs, the LNP site is environmentally suitable for operation of two new AP1000 reactors.

NRC staff reviewed the PEF DBA analysis, which is based on analyses performed for design certification of Revision 17 of the AP1000 reactor design with adjustment for LNP site-specific characteristics. The NRC staff also performed an independent DBA analysis. The results of the PEF and NRC staff analyses indicate that the environmental risks associated with DBAs, if an AP1000 reactor were to be located at the LNP site, would be small. On this basis, the NRC staff concludes that the environmental consequences of DBAs at the LNP site would be SMALL for an AP1000 reactor.

5.11.2 Environmental Impacts of Postulated Severe Accidents

In its ER (PEF 2009a), PEF considers the potential consequences of severe accidents for an AP1000 reactor at the LNP site. Three pathways are considered: (1) the atmospheric pathway in which radioactive material is released to the air; (2) the surface-water pathway in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

PEF's consequence assessment is based on the probabilistic risk assessment (PRA) for Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52, Appendix D. Westinghouse subsequently upgraded and updated the PRA model; however, Westinghouse reviewed the AP1000 probabilistic risk assessment for Revision 15 and concluded that the PRA remains valid for proposed revisions to the DCD (Westinghouse 2007b). The NRC staff evaluated the current PRA model and its results using "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications" (DC/COL-ISG-3) (NRC 2008b) and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. PEF is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA.

5.11.2.1 Internally Initiated Events

The PEF (2008a) evaluation of the potential environmental consequences for the atmospheric and surface-water pathways incorporates the results of the Melcor Accident Consequence Code System (MACCS2) computer code Version 1.12 (Chanin and Young 1997) run using AP1000 reactor source-term information and LNP site-specific meteorological, population, and land-use data. PEF provided the NRC with copies of the input and output files for the MACCS2 computer runs (PEF 2009i). The NRC staff reviewed the files, ran confirmatory calculations, and determined that PEF's results are reasonable.

The MACCS2 computer codes were developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). The MACCS2 codes evaluate the consequences of atmospheric releases of material after a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS2 analysis: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure.

Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination after a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than 0.5 rem/yr if not reduced by decontamination, and that would have a dose rate following decontamination of less than 0.5 rem/yr. Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for an AP1000 reactor at the LNP site is estimated to be 2.2×10^{-7}/reactor-year (Ryr), and the cumulative population dose associated with a severe accident without loss of containment at the site is calculated to be 4.5×10^{3} person-rem (PEF 2009i). The population dose risk for this class of accidents is the product of 2.2×10^{-7}/Ryr and 4.5×10^{3} person-rem, or 9.9×10^{-4} person-rem/Ryr. The following sections discuss the estimated risks associated with each pathway.

The risks presented in the tables that follow are risks per year of reactor operation. PEF has indicated that the LNP site could hold two reactors of the AP1000 reactor design. The consequences of a severe accident would be the same regardless of whether one or two AP1000 reactors were built at the LNP site. If two AP1000 reactors were built, the risks would apply to each reactor, and the total risk for new reactors at the site would be double the risk for a single reactor. A discussion of these risks is presented in the following sections.

5.11.2.2 Air Pathway

The MACCS2 codes directly estimate the consequences of releases to the air pathway. The risks calculated from the results of the MACCS2 runs are presented in Table 5-17. The core damage frequencies (CDFs) given in the following tables are for internally initiated accident sequences while the facility is at power. Internally initiated accident sequences include those that are initiated by human error, equipment failures, loss of offsite power, etc. Estimates of the CDFs for externally initiated events and during shutdown are discussed later.

Table 5-17 shows that the probability-weighted consequences (i.e., risks) of severe accidents for an AP1000 reactor located on the LNP site are small for all risk categories considered. For perspective, Table 5-18 and Table 5-19 compare the health risks from severe accidents for an AP1000 reactor at the LNP site with the risks for current-generation reactors at various sites and with health risks for AP1000 reactors at the North Anna, Clinton, Grand Gulf, and Vogtle early site permit (ESP) sites.

In Table 5-18, the health risks estimated for an AP1000 reactor at the LNP site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-19. Table 5-19 also compares the health risks of an AP1000 reactor at the LNP site with the health risks of an AP1000 reactor at four ESP sites (NRC 2006a, b, c; 2008c; PEF 2009a).

The last two columns of Table 5-18 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the NRC staff compares these estimates to safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Policy Statement expressed the Commission’s policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

• Table 5-17. Mean Environmental Risks from an AP1000 Reactor Severe Accident at the LNP Site

Release Category Description (Accident Class)		Core Damage Frequency (per Ryr)	Environmental Risk					
			Population Dose (person-rem/Ryr)(a)	Fatalities (Ryr^{-1})		Cost(d) ($/Ryr)	Farmland Decontamination(e) (ac/Ryr)	Population Dose from Water Ingestion (person-rem/Ryr)(a)
				Early(b)	Latent(c)			
IC	Intact containment	2.2×10^{-7}	9.9×10^{-4}	0.0×10^{0}	4.5×10^{-7}	0.31	1.6×10^{-6}	2.6×10^{-6}
BP	Containment bypass, fission products released directly to environment	1.1×10^{-8}	4.1×10^{-2}	1.3×10^{-9}	2.0×10^{-5}	328.65	1.3×10^{-3}	1.2×10^{-3}
CI	Containment isolation failure occurs prior to onset of core damage	1.3×10^{-9}	2.0×10^{-3}	1.7×10^{-11}	1.3×10^{-6}	9.64	3.3×10^{-5}	2.7×10^{-5}
CFE	Early containment failure, after onset of core damage but before core relocation	7.5×10^{-9}	1.2×10^{-2}	1.1×10^{-9}	6.5×10^{-6}	68.13	2.7×10^{-4}	1.9×10^{-4}
CFI	Intermediate containment failure, after core relocation but before 24 hr	1.9×10^{-10}	3.0×10^{-4}	3.0×10^{-12}	1.3×10^{-7}	1.67	6.3×10^{-6}	3.3×10^{-6}
CFL	Late containment failure occurring after 24 hr	3.5×10^{-13}	3.2×10^{-7}	0.0×10^{0}	1.0×10^{-10}	0.01	2.7×10^{-8}	7.4×10^{-10}
Total		**2.4×10^{-7}**	**5.6×10^{-2}**	**2.4×10^{-9}**	**2.8×10^{-5}**	**408.40**	**1.6×10^{-3}**	**1.4×10^{-3}**

(a) To convert person-rem to person-Sv, divide by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is area where the average whole body dose rate for the 4-year period following the accident exceeds 0.5 rem/yr but can be reduced to less than 0.5 rem/yr by decontamination.

Table 5-18. Comparison of Environmental Risks for an AP1000 Reactor at the LNP Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150

	Core Damage Frequency (per Ryr)	50-mi Population Dose Risk (person-rem/Ryr)[a]	Fatalities per Reactor-Year		Average Individual Fatality Risk (per Ryr)	
			Early	Latent	Early	Latent Cancer
Grand Gulf[b]	4.0×10^{-6}	5×10^{1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[b]	4.5×10^{-6}	7×10^{2}	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[b]	5.7×10^{-5}	1×10^{3}	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[b]	4.0×10^{-5}	5×10^{2}	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[b]	3.4×10^{-4}	5×10^{3}	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
AP1000[c] Reactor at the LNP site	2.4×10^{-7}	5.6×10^{-2}	2.4×10^{-9}	2.8×10^{-5}	1.2×10^{-11}	3.9×10^{-11}
AP1000[d] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}	1.2×10^{-10}	4.0×10^{-5}	2.6×10^{-13}	4.9×10^{-11}
AP1000[e] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}	1.4×10^{-8}	1.2×10^{-5}	6.4×10^{-13}	5.5×10^{-11}
AP1000[f] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}	$<1.0 \times 10^{-12}$	6.9×10^{-6}	$<1.0 \times 10^{-14}$	2.0×10^{-11}
AP1000[g] Reactor at the VEGP site	2.4×10^{-7}	2.8×10^{-2}	1.9×10^{-10}	1.9×10^{-5}	1.6×10^{-12}	1.1×10^{-11}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(c) Calculated with MACCS2 code using LNP site-specific input.
(d) NUREG-1811 (NRC 2006a).
(e) NUREG-1815 (NRC 2006b).
(f) NUREG-1817 (NRC 2006c).
(g) NUREG-1872 (NRC 2008c).

Table 5-19. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an AP1000 Reactor at the LNP Site with Risks Initiated by Internal Events for Current Nuclear Power Plants Undergoing Operating License Renewal Review and Environmental Risks of the AP1000 Reactor at Other Sites

	Core Damage Frequency (per year)	**50-mi Population Dose Risk (person-rem/Ryr)[(a)]**
Current reactor maximum[(b)]	2.4×10^{-4}	6.9×10^{1}
Current reactor mean[(b)]	2.7×10^{-5}	1.6×10^{1}
Current reactor median[(b)]	1.6×10^{-5}	1.3×10^{1}
CREC Unit 3[(c)]	5.0×10^{-6}	4.0×10^{0}
Current reactor minimum[(b)]	1.9×10^{-6}	3.4×10^{-1}
AP1000 LNP Unit 1 or 2[(d)(e)]	2.4×10^{-7}	5.6×10^{-2}
AP1000[(f)] reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}
AP1000[(g)] reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}
AP1000[(h)] reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}
AP1000[(i)] reactor at the Vogtle site	2.4×10^{-7}	2.8×10^{-2}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Based on MACCS (Chanin et al. 1990) and MACCS2 (Chanin and Young 1997) calculations for 76 current plants at 44 sites.
(c) PEF 2008b.
(d) PEF 2009a, LNP MACCS2 Results.
(e) Calculated with MACCS2 code using LNP site-specific input.
(f) NUREG-1811 (NRC 2006a).
(g) NUREG-1815 (NRC 2006b).
(h) NUREG-1817 (NRC 2006c).
(i) NUREG-1872 (NRC 2008c).

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed 0.1 of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed 0.1 of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed" is about 4.0×10^{-4}/yr, including a 1.6×10^{-4}/yr risk associated with transportation accidents (NSC 2006). One-tenth of 1 percent of these figures imply that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7}/Ryr.
- "The sum of cancer fatality risks that result from all other causes" for an individual is taken to be the cancer fatality rate in the United States, which is about 1 in 500 or 2×10^{-3}/yr (Reed 2007). One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant from its operation should be limited to 2×10^{-6}/Ryr.

MACCS2 calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. Risks calculated by PEF for the AP1000 reactor design at the LNP site are also well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for an AP1000 reactor at the LNP site with statistics summarizing the results of contemporary severe accident analyses performed for 76 reactors at 44 sites. The results of these analyses are included in the final site-specific Supplements 1 through 37 to the GEIS for license renewal (NUREG-1437) (NRC 1996) and in the ERs included with license renewal applications for the power stations for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990), and the analyses for 72 of the reactors used MACCS2, which was released in 1997. Table 5-19 shows that the CDF estimated for the AP1000 reactor is significantly lower than those of current-generation reactors. Similarly, the population doses estimated for an AP1000 reactor at the LNP site are well below the mean and median values for current-generation reactors undergoing license renewal.

Finally, the population dose risk from a severe accident for an AP1000 reactor at the LNP site, 5.6×10^{-2} person-rem/Ryr (PEF 2009a), may be compared with the dose risk for normal operation of a single AP1000 reactor at the LNP site, 6.1 person-rem/Ryr (PEF 2009a); comparatively, the population dose risk for a severe accident is small.

5.11.2.3 Surface-Water Pathway

Surface-water dose pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water and include ingestion of water and aquatic foods as well as water submersion and activities occurring near the water. Of these surface-water pathways, the ingestion of contaminated water was evaluated by MACCS2 codes. The risks associated with this pathway were calculated for the LNP site and are included in the last column of Table 5-17. The water-ingestion dose risk of about 1.4×10^{-3} person-rem/Ryr is small compared to the total dose risk of 5.6×10^{-2} person-rem/Ryr (PEF 2009a).

PEF based its assessment of the impacts of submersion in water and ingestion of aquatic food on the analyses presented in NUREG-1437 for license renewals for current-generation reactors (NRC 1996), which relies on the analysis in the Fermi Final Environmental Statement (NRC 1981, 1982) and the Liquid Pathway Generic Study (NRC 1978). These analyses indicate that the aquatic-food pathway is about a factor of 20 larger than the water-ingestion pathway dose, which is slightly larger than the dose from shoreline activities and significantly larger than the dose from swimming. They also indicate that interdiction can reduce doses by as much as a factor of 10. The MACCS2 results in Table 5-17 show that the water-ingestion dose is a small fraction of the air-pathway dose. This indicates that the doses from shoreline activity and swimming would also be small. The NRC staff concurs that the risks associated with shoreline activities and swimming would be significantly smaller than the air-pathway dose risk, particularly if interdiction is considered.

With respect to the aquatic-food dose, the ER states: "For coastal and estuary sites with large annual aquatic harvests, interdiction can provide dose reductions such that the population dose is essentially the same as the atmospheric pathway which is considered a SMALL impact." The ER then goes on to note that the LNP site is about 8 mi from the coast and therefore the doses for the LNP would be lower than for a true coastal site.

The NRC staff notes that Table 5.16 of NUREG-1437 contains an estimate of aquatic-food doses and dose risks for CREC Unit 3. The food dose is estimated as 1.5×10^{8} person-rem and the dose risk as 1.4×10^{3} person-rem/Ryr. The relevant CDF for CREC Unit 3 is 5×10^{-6}/Ryr (PEF 2008b). Adjusting the CREC aquatic-food dose for differences in CDFs and reactor power levels, the staff estimates that the aquatic-food dose for the LNP would be about 2 person-rem/Ryr if the LNP were located at the CREC site. Finally, the staff notes that the deposition between the LNP site and the coast and interdiction of aquatic food would significantly reduce the aquatic-food dose risk. On this basis, the NRC staff believes that the aquatic-food pathway risk with interdiction may be comparable to or larger than the air-pathway risk, but that it is small compared to the risk of normal operation or a severe accident at CREC Unit 3.

5.11.2.4 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris reaches groundwater where soluble radionuclides are transported with the groundwater. In NUREG-1437, the NRC staff assumed that the probability of a severe accident with basemat penetration was 1×10^{-4}/Ryr and concluded that the groundwater-pathway risks were small. The PEF ER summarizes the discussion in NUREG-1437 and reaches the same conclusion.

The NRC staff has re-evaluated its assumption of a 1×10^{-4}/Ryr probability of a basemat melt-through. The NRC staff believes that the 1×10^{-4} probability is too large for new power stations. Design elements have been included in the AP1000 design to minimize the potential for reactor core debris to reach groundwater. These elements include external reactor vessel cooling and ex-vessel core debris cooling. Further, the probability of core melt with a basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-17 gives a total CDF estimate of 2.4×10^{-7}/Ryr for the AP1000 reactor. NUREG-1150 indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. If the CDF for AP1000 severe accidents in which containment remains intact are subtracted from the total AP1000 CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the CDF is on the order of 2×10^{-8}/Ryr. On this basis, the staff believes that a basemat melt-through probability of 2×10^{-8}/Ryr is reasonable and still conservative. The groundwater pathway is also more tortuous and affords more time for implementing protective actions than the air pathway and, therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on the overall plant risk.

5.11.2.5 Externally Initiated Events

The analyses described above are specifically for internally initiated events. The ER states that the combined CDF for internal fires and floods, which are external initiating events, is about 24 percent of the total CDF for internal initiating events. The ER then states that the CDF for all events, including internal events, floods, fires, earthquakes, etc., may be estimated by multiplying the internal events CDF by a factor of 2 (PEF 2009a).

The AP1000 reactor vendor and NRC staff have addressed three externally initiated events during design certification of the AP1000 reactor: seismic, internal fire, and internal flooding events. The analyses are described Section 19.1.5 of the Final Safety Evaluation Report (FSER) for the Revision 15 of the AP1000 reactor design (NRC 2004a).

With respect to seismic events, the AP1000 reactor vendor performed a PRA-based seismic margin analysis. The analysis results indicated that there is high confidence (95 percent) that safety systems and components would survive a 0.5-g peak acceleration during a seismic event. The safe-shutdown earthquake for the AP1000 reactor design is 0.3 g. Consequently, the NRC staff concluded in the FSER that the AP1000 reactor design is acceptable (NRC 2004a).

With respect to internal fires, the AP1000 reactor vendor estimated the fire-induced CDFs to be about 5.6×10^{-8} yr^{-1} during power operation and about 8×10^{-8} yr^{-1} during shutdown, and considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs (NRC 2004a).

With respect to internal flooding, the AP1000 reactor vendor did not perform a detailed PRA to assess the risk from internal flooding. Instead, the vendor performed an internal flooding PRA commensurate with the level of detail available and, where detailed information was not available, made conservative assumptions to bound the flooding analysis. In its safety review, the NRC staff found that this analysis was adequate to identify potential vulnerabilities and to lend insight into the design that could be used to support design-certification requirements. Quantification of potential scenarios with the plant at power resulted in a total CDF from internal floods of about 1×10^{-9} yr^{-1}. The CDF from internal floods when the power station is shutdown is estimated to be about 3.2×10^{-9} yr^{-1}. The vendor considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal floods in a manner superior to operating plants and is consistent with the conclusions from the vendor's internal flood risk analysis (NRC 2004a).

5.11.2.6 Summary of Severe Accident Impacts

The PEF application refers to proposed Revision 17 of the AP1000 reactor certified design (10 CFR Part 52, Appendix D). The consequence assessment is based on the PRA for Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52, Appendix D. Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2007a). The NRC staff evaluated the current PRA model and its results using DC/COL-ISG-3 (NRC 2008b), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. PEF is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the staff to materially change its conclusions related to severe accident risks.

The NRC staff reviewed the risk analysis in the ER and conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for the proposed LNP Units 1 and 2 using the MACCS2 code. The results of both the PEF analysis and the NRC evaluation indicate that the environmental risks associated with severe accidents if an AP1000 reactor were to be located at the LNP site would be small compared with risks associated with operation of the current-generation reactors at other sites. These risks are below the NRC safety criteria. On these bases, the NRC staff concludes that the probability-weighted consequences of severe accidents at the LNP site would be SMALL for an AP1000 reactor.

5.11.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are severe accident mitigation design alternatives (SAMDAs), procedural modifications, or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000b). PEF based its COL application on the AP1000 reactor design (see Appendix D of 10 CFR Part 52 – Design Certification Rule for the AP1000 Design), which incorporates many features intended to reduce severe accident CDFs and the risks associated with severe accidents. The effectiveness of the AP1000 reactor design features is evident in Table 5-18 and Table 5-19, which compare CDFs and severe accident risks for the AP1000 reactor with CDFs and risks for current-generation reactors. The CDFs and risks have generally been reduced considerably when compared to the existing current-generation reactors.

Consistent with the direction from the Commission to consider the SAMDAs at the time of certification, the AP1000 reactor vendor (Westinghouse 2005) and the NRC staff (NRC 2004b, 2005), considered a number of design alternatives for an AP1000 reactor at a generic site. The conclusion of the NRC staff's review was

> …that none of the potential design modifications evaluated are justified on the basis of cost-benefit considerations. NRC further concludes that it is unlikely that any other design changes would be justified in the future on the basis of person–rem exposure because the estimated CDFs are very low on an absolute scale.

Westinghouse reviewed the AP1000 PRA for Revision 15 and concluded that the PRA remains valid for the proposed revisions to the DCD (Westinghouse 2007a); this is unchanged for Revision 17. Furthermore, the NRC staff evaluated the current PRA using DC/COL-ISG-3 (NRC 2008b), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the PRA submitted with Revision 15 is a conservative and acceptable basis for evaluating severe accidents and strategies for mitigating them. Therefore, the NRC staff considers the PRA for DCD Revision 15 to be an adequate basis for a SAMDA analysis for an application referencing DCD Revision 17. Consequently, the NRC staff incorporates by reference the environmental assessment accompanying the design-certification rulemaking for Appendix D to 10 CFR Part 52 (NRC 2006a, b, c).

Section 5.11.2 presents the environmental risks from various classes of severe accidents for the LNP site. Site-specific information appears in SAMDA evaluations as population dose risk (person-rem/Ryr) and offsite economic costs ($/Ryr). The staff considers these two elements to be the appropriate metrics to use to determine whether the site characteristics are bounded by the site parameters because they are calculated from the site-specific meteorology, population distribution, and land-use data. Appendix 1B of the AP1000 DCD lists the population dose risk (person-rem/Ryr) used in the DCD generic SAMDA review. While it does not list the offsite economic costs, it does include a maximum attainable benefit that considers offsite economic costs, onsite exposure costs, onsite cleanup costs, and replacement power costs, in addition to the cost associated with the offsite population dose risk. To perform a like-kind comparison, the NRC staff used the maximum attainable benefit cost for the LNP site characteristic. The probability-weighted, mean population dose risks from Table B1-1 in Appendix 1B and the base-case maximum attainable benefit listed in Table B1-4 are the metrics used by the NRC staff to determine whether the LNP site characteristics are within the site parameters specified in Appendix 1B.

Table 5-20 presents the comparison of LNP site-specific metric values (PEF 2009a) with the generic values from Appendix 1B of the AP1000 DCD (Westinghouse 2008). Table 5-20 shows that the population dose risk for the LNP site is about 33 percent larger than the DCD Appendix 1B value, while the maximum attainable benefit for the LNP site is only about 60 percent of the DCD Appendix 1B value.

Table 5-20. Comparison of LNP SAMDA Site Characteristics with Site Parameters Specified in AP1000 DCD Appendix 1B

	Population Dose Risk, person-rem/Ryr	Maximum Attainable Benefit
DCD Appendix 1B (internal events)	4.3×10^{-2}	$21,000
LNP site (internal events)	5.6×10^{-2}	$12,700
LNP site risk as fraction of DCD risk	133 percent	60 percent

The generic AP1000 SAMDA analysis is presented in Appendix 1B of the DCD (Westinghouse 2008). Design alternatives considered by Westinghouse and their estimated implementation costs are presented in Table 5-21 (Westinghouse 2008). In the base-case analysis, the benefit-cost methodology of NUREG/BR-0184 (NRC 1997) is used to calculate the maximum attainable benefit. The analysis assumes that the implementation of the design alternative completely eliminates all potential for core damage. For the AP1000, the maximum attainable benefit was valued at $21,000 in Appendix 1B, Section 1B.1.8 of the AP1000 CDC Revision 17 (Westinghouse 2008). Only one design alternative in Table 5-21 – the self-actuating containment isolation valves – has a cost ($33,000) that is comparable to the maximum attainable benefit. To evaluate the benefit of this SAMDA, the design change was assumed to eliminate the containment isolation severe accident release category, which is only a small contributor to the total CDF. Therefore, this design alternative provides almost no benefit in reducing the AP1000 CDF.

Table 5-21. Design Alternatives Considered for SAMDA in the AP1000 DCD

No.	Design Alternative	Cost ($)
1	Upgrade chemical, volume, and control system for small loss-of-coolant accident (LOCA)	1,500,000
2	Containment filtered vent	5,000,000
3	Self-actuating containment isolation valves	33,000
4	Safety grade passive containment spray	3,900,000
6	Steam generator shell-side heat removal	1,300,000
7	Steam generator relief flow to in-containment refueling water storage tank (IRWST)	620,000
8	Increased steam generator pressure capability	8,200,000
9	Secondary containment ventilation with filtration	2,200,000
10	Diverse IRWST injection valves	570,000
12	Ex-vessel core catcher	1,660,000
13	High-pressure containment design	50,000,000
14	More reliable diverse actuation system	470,000

Source: Westinghouse 2008

The PEF ER updates the SAMDA analysis conducted for AP1000 design certification using the results of the LNP site-specific consequence analysis (MACCS2) discussed in Section 7.2 of the ER. The results of the PEF analysis indicate that the maximum potential benefit if the total risk for the LNP could be reduced to zero has a value of about $26,000. Similar to the finding in the AP1000 DCD SAMDA analysis, only the self-actuating containment isolation valves design alternative (Table 5-21) has a value comparable to the maximum attainable benefit for the LNP site.

Table 5-17, which lists the mean environmental risks from an AP1000 reactor severe accident at the LNP site, shows that the containment isolation severe accident category only contributes a small fraction to the total population dose (approximately 1 percent) and cost risk (approximately 0.1 percent) at the LNP site. Assuming that implementation of the self-actuating containment isolation valves completely eliminates the risks associated with this release category, then the value of the reduction in risk would only be about $260. Thus, the site-specific SAMDA review conducted by PEF confirms the results of the design-certification SAMDA review. Although the dose risk for the LNP site exceeds the DCD value, the site-specific SAMDA analysis for the LNP site shows that the resulting design alternative (self-actuating containment isolation valves) would only reduce this total risk by a small fraction. The next lowest cost design alternative has more than an order-of-magnitude higher cost than the self-actuating containment isolation valves. On this basis, the NRC staff concludes that, in fact, there are no potential design modifications that are justified on the basis of benefit-cost considerations, and it is unlikely that any other design changes would be justified in the future on the basis of person-rem exposure because the estimated CDFs are very low on an absolute scale.

The PRA upon which the AP1000 and LNP severe accident reviews are based was conducted for Revision 15 of the AP1000 design. Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2007a). The NRC staff evaluated the current PRA model and its results using DC/COL-ISG-3 (NRC 2008b), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. PEF is required by regulation to update the PRA prior to fuel loading. The NRC staff expects the PRA to be site-specific rather than use the bounding assumptions used for the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the NRC staff to conclude that any SAMDA considered in the design-certification process would become cost beneficial.

The SAMDA issue is a subset of the SAMA review. The other attributes of the SAMA review, namely procedural modifications and training activities, have not yet been addressed by PEF. However, PEF has stated (PEF 2009a) that risk insights would be considered in the development of plant procedures and training. Because the maximum attainable benefit is so low, a SAMA based on procedures or training for an AP1000 reactor at the LNP site would have to reduce the CDF or risk to near zero to become cost beneficial. Based on its evaluation, the staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk that much. Therefore, the staff further concludes it is unlikely that these SAMAs would be cost effective. In addition, based on statements by PEF in the ER (PEF 2009a), the staff expects that PEF will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the staff's conclusions because the staff already concluded procedural and training SAMAs would be unlikely to be cost effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for AP1000 reactors at the LNP site. Based on the information provided by PEF and the NRC's independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed LNP Units 1 and 2 would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of proposed Units 1 and 2, the review team relied on PEF's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts
- compliance with applicable requirements of permits or licenses required for operation of the new units (e.g., National Pollutant Discharge Elimination System permit)
- compliance with existing CREC processes and/or procedures applicable to proposed LNP Units 1 and 2 operational environmental compliance activities for the LNP site
- compliance with existing CREC procedures for environmental control and management applicable to proposed LNP Units 1 and 2
- Compliance with FDEP Conditions of Certification
- implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-22, which is the staff's adaptation from sections of PEF's ER Table 5.10-1 (PEF 2009a), lists a summary of measures and controls to limit adverse impacts during operation proposed by PEF.

Table 5-22. Summary of Proposed Measures and Controls to Limit Adverse Impacts During Operation

Resource Category	Specific Measures and Controls
Land Use	Onsite land-use impacts from operation of LNP Units 1 and 2 are expected to be minimal because minimal additional land would be affected other than the land disturbed during erection of the plant. Stormwater controls would be maintained during operations to minimize erosion and sedimentation onsite. Land-use impacts during transmission-line operations would be associated with corridor maintenance activities for actions such as vegetation management, tower repairs, and habitat maintenance. Maintenance practices are designed to be both preventative and corrective. No ground-disturbing activities are planned to occur during the maintenance of transmission lines. Stormwater controls would be maintained during operations to minimize erosion and sedimentation in the offsite areas.
Water-Related	
Hydrologic Alterations	The FDEP conditions of certification require PEF to develop an environmental monitoring plan, which includes a hydraulic testing program during drilling and construction of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater-usage impacts without significantly affecting water levels in the surficial aquifer. Conditions of certification require that operational impacts of the LNP wellfield limit drawdowns in the surficial aquifer to levels that ensure no adverse impacts on wetlands.
Water-Use Impacts	No mitigation would be required for pumping water from the Gulf of Mexico via the CFBC.
Water-Quality Impacts	PEF would obtain a new NPDES permit or seek modifications to the CREC NPDES permit to allow LNP blowdown discharge to the Gulf of Mexico via the CREC discharge canal. PEF would comply with the NPDES permit limits and monitoring requirements for discharges to the Gulf of Mexico. No mitigation would be required for changes in water movement and temperature changes associated with the operation of the LNP intake. A groundwater quality monitoring program would be instituted to detect any detrimental impacts, and wellfield operations would be managed to mitigate any significant decreases in water quality.

Table 5-22. (contd)

Impact Category	Specific Measures and Controls
Ecology	
Terrestrial Ecosystems	Light pollution during facility operation could affect wildlife residing on or migrating through the LNP site. Possible mitigation measures could include the use of lower-wattage lights, hooded or down-turned lights, and turning unnecessary lights off at night. A condition of certification by the FDEP would require the applicant to develop an Avian Protection Plan for the transmission lines that would include measures to reduce the potential for bird collisions with structures and lines. Vegetation control for transmission-line maintenance within wetlands would follow restrictive vegetation-clearing practices (hand clearing with chain saws or use of low-ground pressure shear or rotary machines to reduce soil compaction and limit vegetation damage). Whenever maintenance is required in wetlands and other environmentally sensitive areas not served by access roads or fill pads, temporary matting would be used as necessary to minimize damage to wetland soils during repairs. Chemical methods of vegetation control within transmission lines would only include the use of herbicides registered by the EPA and approved by the State of Florida. Herbicide use would be in accordance with manufacturer specifications and carried out by licensed applicators. Stormwater from the newly developed facilities would be collected through a stormwater-drainage system and directed into three stormwater-retention and/or infiltration ponds for treatment. Stormwater runoff from roadways would be managed using a series of roadside swales. These stormwater facilities would minimize impacts on wetlands from stormwater runoff and would allow for aquifer recharge of stormwater via infiltration. Uncertainty exists regarding the potential for wetland impacts from groundwater withdrawal. Hydrological monitoring to ensure that groundwater withdrawals do not adversely affect wetlands would be required under the State-imposed conditions of certification. If wellfield aquifer performance testing, revised groundwater modeling, or environmental monitoring of wetlands should detect adverse wetland impacts, PEF would be required to mitigate the impacts or implement an approved alternative water-supply project.

Table 5-22. (contd)

Impact Category	Specific Measures and Controls
	Unavoidable wetland impacts would be mitigated in compliance with Federal and State permitting processes. PEF has prepared a mitigation plan that would compensate for the loss or impairment of wetland functions affected by operation of the LNP site and the associated offsite facilities. PEF has committed to providing at least as many Uniform Mitigation Assessment Methodology functional lift units as the actual LNP project losses incurred. A condition of certification by the FDEP would require protocol surveys for listed species (excluding plants) that may occur on the LNP site and associated offsite facilities prior to land "clearing and construction". If listed species are detected and operational impacts cannot be avoided, appropriate mitigation may be required on a case-by-case basis as determined through consultation with the FFWCC. Under wetland mitigation planning, several hundred acres of low-value pine plantations and degraded wetlands would be rehabilitated and restored to native upland and wetland plant communities. The higher-quality habitat provided by these restored communities would likely be beneficial to many listed species.
Aquatic Ecosystems	Closed-cycle cooling, intake screens parallel with canal flow, and low approach velocity of traveling screens minimize impingement and entrainment. Discharges to the Gulf of Mexico are expected to meet NPDES permitting requirements. Chemical discharges would be monitored and concentrations are expected to be below criteria that are protective of aquatic life. Aquatic resources in transmission-line corridors are protected during maintenance by maintaining 25-ft buffer zones of existing vegetation with mature heights not exceeding 12 ft at locations where the transmission-line corridor crosses a navigable waterway with limited use of herbicides near these buffer zones following PEF's Transmission Vegetation Management Program.
Socioeconomic Impacts	
Physical Impacts	PEF would obtain air permits and operate systems within permit limits and monitor emissions as required, and would employ BMPs in operating and maintaining the facility and site.
Community Impacts	PEF would stagger outages and outage-workforce schedules to moderate traffic congestion and reduce extreme fluctuation in the number of temporary workers seeking short-term housing.

Table 5-22. (contd)

Impact Category	Specific Measures and Controls
Environmental Justice	There are no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations.
Historic and Cultural Resources	Take appropriate actions as required by site procedures following discovery of potential historic or archaeological resources and Florida State site certification process.
Air Quality	PEF would obtain air permits and operate systems within permit limits and monitor emissions as required.
	Operation of the proposed Units 1 and 2 cooling towers would result in water vapor plumes that would occur in each direction of the compass and would be spread over a wide area, reducing the time that the plume would be visible from any particular location. The average plume lengths would be short and would not be long enough to reach the site boundary in most directions. No mitigation would be required.
	Operation of the cooling towers could lead to minor shadowing, very small increase in precipitation, increases in ground-level humidity in the immediate vicinity, and salt deposition that is a fraction of the level needed to have visible effects on vegetation outside the site boundaries (greater than 1300 ft). No mitigation would be required.
Radiological Impacts of Normal Operation	
Radiation Doses to Members of the Public	Calculated radiation doses to members of the public within NRC and EPA standards (10 CFR Part 20, Appendix I of 10 CFR Part 50, and 40 CFR Part 190).
	Radiological effluent and environmental monitoring programs would be implemented.
Occupational Radiation Doses	Estimated occupation doses are within NRC standards (10 CFR Part 20).
	Program would be implemented to maintain occupational doses ALARA (10 CFR Part 20).
Radiation Doses to Biota Other Than Humans	Calculated doses for biota are well within NCRP and IAEA guidelines.
	Radiological environmental monitoring program would be implemented.

Table 5-22. (contd)

Impact Category	Specific Measures and Controls
Nonradioactive Waste	
Nonradioactive Waste System Impacts	Nonhazardous, nonradioactive, solid waste generated during operation would be segregated and recycled to the extent practicable. All solid wastes would be transported offsite by licensed contractors to existing, licensed, disposal facilities operating in compliance with all applicable Federal, State and local requirements. No solid wastes would be burned or disposed of onsite during operation. All nonradioactive liquid wastes from the LNP facility would be combined into a single, permitted, and monitored stream that would discharge via the CREC discharge canal into the Gulf of Mexico. PEF would comply with the NPDES permit, including implementing a stormwater pollution prevention plan. Nonradioactive gaseous emissions from operations would be limited in magnitude. PEF would install equipment with appropriate emission controls and comply with all applicable Federal, State and local air quality requirements. The small quantities of expected nonradioactive hazardous waste would be managed and disposed of in accordance with Federal, State, and local requirements. PEF has corporate programs in place to manage hazardous wastes.
Mixed Waste Impacts	The mixed waste from the LNP facility would be handled and managed in accordance with the applicable Federal, State, and local requirements. The packaged waste would be stored in the auxiliary and radwaste buildings until it is shipped offsite to a licensed disposal facility.
Accidents	
Design Basis Accidents	Calculated dose consequences of design basis accidents for the AP1000 at the LNP site were found to be within regulatory limits.
Severe Accidents	Calculated probability-weighted consequences of severe accidents for the AP1000 at the LNP site were found to be lower than the probability- weighted consequences for current operating reactors. The LNP site parameters are within the site parameters considered in the design-certification review of severe accident mitigation design alternatives. Therefore, issues related to severe accident mitigation design alternatives are resolved. Procedural and training alternatives would be considered when procedures are developed.

Table 5-22. (contd)

Impact Category	Specific Measures and Controls
Nonradiological Health Impacts	Exposure to etiological agents (thermophilic organisms) would be limited because discharge is in a control area and recreational use of area is prohibited. Noise during operation would be maintained below Levy County standards (PEF 2009a). The potential for acute effects of electromagnetic fields from transmission lines would be reduced by conformance to National Electric Safety Code standards (PEF 2009a). Occupational injury and fatality risks would be reduced by strict adherence to PEF's industrial safety program and NRC, OSHA, and State safety standards, practices, and procedures (FDEP 2010). To mitigate potential transportation fatalities, PEF could develop and implement a traffic-management plan.

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations of proposed LNP Units 1 and 2 is summarized in Table 5-23. Impact levels are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level column.

Table 5-23. Summary of Operational Impacts at the Proposed LNP Site

Resource Category	Comments	Impact Level
Land-Use Impacts		
Site	No adverse impacts projected.	SMALL
Transmission Lines and Offsite Areas	No adverse impacts projected.	SMALL
Water-Related Impacts		
Water Use – Surface Water	Operational activities would have negligible impacts on surface-water availability.	SMALL
Water Use – Groundwater	Operational activities would have negligible impacts on groundwater availability.	SMALL
Water Quality – Surface Water	Operational activities would have negligible impacts on surface-water quality.	SMALL
Water Quality – Groundwater	Operational activities would have negligible impacts on groundwater quality.	SMALL

Table 5-23. (contd)

Resource Category	Comments	Impact Level
Ecological Impacts		
Terrestrial Ecosystems	A range is provided to account for the uncertainty that exists regarding the potential effects of groundwater withdrawal on wetlands and associated biota.	SMALL to MODERATE
Aquatic Ecosystems	Impacts on aquatic ecosystems onsite and at offsite facilities would be negligible. Impacts on aquatic ecosystems from operation of the CWIS and dredging would be minor. Impacts on aquatic organisms from operations of the CREC would be minor.	SMALL
Socioeconomic Impacts		
Physical	Limited impacts, because most activities would be conducted within enclosed facilities, would be further reduced by use of BMPs, use of site buffering, and traffic management for the smaller workforce.	SMALL
Aesthetics	MODERATE aesthetic impacts created along transmission-line corridors would continue throughout the life of the project.	MODERATE
Demography	In-migrating workers and their families would contribute less than a one-half of 1 percent increase to projected populations for 50-mi region or any economic impact area county	SMALL
Economic Impacts on Community	Added jobs and associated earnings would cause a SMALL positive impact on the economy of the three counties in the socioeconomic impact area Impacts on commercial and recreational fishing would be SMALL.	SMALL Beneficial
Taxes	Tax base impacts would be SMALL except in Levy County, where they would be LARGE and beneficial.	SMALL to LARGE Beneficial
Infrastructure and Community Services	The operations workforce and in-migrating population would be fewer than during site preparation activities and would have a minor impact.	SMALL
Environmental Justice	No environmental pathways or health and other preconditions of the minority and low-income populations were found that would lead to adverse and disproportionate impacts.	SMALL

Table 5-23. (contd)

Resource Category	Comments	Impact Level
Historic and Cultural Resources	Based on PEF procedures and commitments to follow those procedures and Florida State site certification conditions, if historical and cultural resources are discovered, the impacts would be SMALL.	SMALL
Meteorology and Air Quality Impacts	Operation of the cooling tower and intermittent operation of various diesel generators would be the primary emissions sources for air pollutants.	SMALL
Nonradiological Health Impacts	Risks from etiological agents would be reduced below current low level. Noise impacts would-be minimal, complying with all Federal, State, and county regulations. Occupational safety and health impacts would be limited by compliance with PEF's industrial safety program, and NRC, OSHA, and State regulations. Acute effects of electromagnetic fields would be avoided by compliance with NESC standards. Transportation impacts would be minimal.	SMALL
Radiological Health Impacts		
Members of the Public	Doses to members of the public would be below NRC and EPA standards and there would be no observable health impacts (10 CFR Part 20, Appendix I to 10 CFR Part 50, 40 CFR Part 190).	SMALL
Plant Workers	Occupational doses to plant workers would be below NRC standards and program to maintain doses ALARA would be implemented.	SMALL
Biota other than Humans	Doses to biota other than humans would be well below NCRP and IAEA guidelines.	SMALL
Nonradioactive Waste Impacts	Proposed practices for recycling, minimizing, managing, and disposing of wastes and the requirement to obtain regulatory approvals for waste disposal and discharges would help minimize impacts from waste generation at LNP Units 1 and 2.	SMALL
Impacts of Postulated Accidents		
Design Basis Accidents	Impacts of design basis accidents would be well below regulatory limits.	SMALL
Severe Accidents	Probability-weighted consequences of severe accidents would be lower than the probability-weighted consequences for currently operating reactors.	SMALL

5.14 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, “Standards for Protection Against Radiation.”

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10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, “Reactor Site Criteria.”

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, “Occupational Safety and Health Standards.”

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, “Protection of Historic Properties.”

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of proposed Levy Nuclear Plant (LNP) Units 1 and 2 in Levy County, Florida.

In its evaluation of uranium fuel-cycle impacts from proposed Units 1 and 2 at the LNP site, Progress Energy Florida, Inc. (PEF) used the AP1000 advanced passive pressurized water reactor design. The capacity factor reported by PEF for the AP1000 reactor design is 93 percent (PEF 2009a). The results reported here apply to the impacts from two Westinghouse Electric Company, LLC (Westinghouse) AP1000 pressurized water reactor units.

6.1 Fuel-Cycle Impacts and Solid-Waste Management

This section discusses the environmental impacts from the uranium and solid-waste management for the AP1000 reactor design. The environmental impacts of this design are evaluated against specific criteria for light water reactor (LWR) designs at Title 10 of the Code of Federal Regulations (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state that

> Under § 51.10, every environmental report prepared for the construction permit stage or early site permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of 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 to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The AP1000 reactors proposed for the LNP site are LWRs that would use uranium dioxide fuel; therefore, Table S–3 (10 CFR 51.51) can be used to assess environmental impacts of the uranium fuel cycle. Table S–3 values are normalized for a reference 1000-MW(e) LWR at an 80-percent capacity factor. The Table S–3 values are reproduced in Table 6-1. The power rating for the proposed Units 1 and 2 at the LNP site is 2074 MW(e), assuming that two AP1000 reactors would be located on the LNP site (PEF 2009a), with a capacity factor of 93 percent.

Specific categories of environmental considerations are included in Table S–3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high-level and low-level wastes, and radiation doses from transportation and occupational exposures. In developing Table S–3, the U.S. Nuclear Regulatory Commission (NRC) staff considered two fuel-cycle options that differed in the treatment of spent fuel removed from a reactor. The “no-recycle” option treats all spent fuel as waste to be stored at a Federal waste repository, whereas, the “uranium-only recycle” option involves reprocessing spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, use, and ultimate disposition of fuel for nuclear power reactors.

Table 6-1. Table S–3 from 10 CFR 51.51(b), Table of Uranium Fuel-Cycle Environmental Data[(a)]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Natural Resource Use		
Land (ac):		
Temporarily committed[(b)]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110-MW(e) coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to a 95-MW(e) coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1000-MW(e) LWR with cooling tower.
Discharged to waterbodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1000-MW(e) LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45-MW(e) coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1000-MW(e) energy output.
Effluents – Chemical (MT)		
Gases (including entrainment):[(c)]		
SO_x	4400	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
NO_x[(d)]	1190	Equivalent to emissions from a 45-MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
Other gases:		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of State standards – below level that has effects on human health.
HCl	0.014	
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are NH_3 – 600 cfs, NO_3 – 20 cfs, Fluoride – 70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	0.4	
Tailings solutions (thousands of MT)	240	From mills only – no significant effluents to environment.
Solids	91,000	Principally from mills – no significant effluents to environment.
Effluents – Radiological (curies)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling – included tailings liquor and returned to ground – no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Th-234	0.01	From fuel fabrication plants – concentration 10 percent of 10 CFR Part 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried onsite):		
Other than high level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning – buried at land burial facilities. 600 Ci comes from mills – included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent-fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents – thermal (billions of British thermal units)	4063	<5 percent of model 1000-MW(e) LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

(a) In some cases where no entry appears, it is clear from the background documents the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S–3 does not include health effects from the effluents described in the table, estimates of releases of radon-222 from the uranium fuel cycle, or estimates of technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings. Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248 (AEC 1974); the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248) (NRC 1977b); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium-only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S–4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S–3A of WASH-1248.

(b) The contributions to temporarily committed land from reprocessing are not prorated over 30 years because the complete temporary impact accrues regardless of whether the plant services one reactor for 1 year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2 percent from natural gas use and process.

In 1978, the Nuclear Non-Proliferation Act of 1978, as amended (Public Law 95-242.) was enacted. This law significantly affected the disposition of spent nuclear fuel by indefinitely deferring the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005, as amended (42 USC 15801 et seq.) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel-recycling technology research and development program to evaluate proliferation-resistant fuel-recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional DOE efforts would be required before commercial reprocessing and recycling of spent fuel produced in U.S. commercial nuclear power plants could commence.

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an in situ leach-solution mining process. In situ leach mining, presently the primary form of mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or in situ leach solution is transferred to mills where it is processed to produce “yellowcake” (U_3O_8). A conversion facility prepares the uranium oxide (UO_2) by converting it to uranium hexafluoride (UF_6), which is then processed by an enrichment facility to increase the percentage of the more fissile isotope uranium-235 and decrease the percentage of the non-fissile isotope uranium-238. At a fuel fabrication facility, the enriched uranium, which is approximately 5-percent uranium-235, is then converted to UO_2. The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are destined to be placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reaction has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After being stored onsite for sufficient time to allow for short-lived fission product decay and to reduce the heat-generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent-fuel elements in a repository constitutes the final step in the no-recycle option.

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (Table 6-1) and the NRC staff’s analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999),[a] the NRC staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design

(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

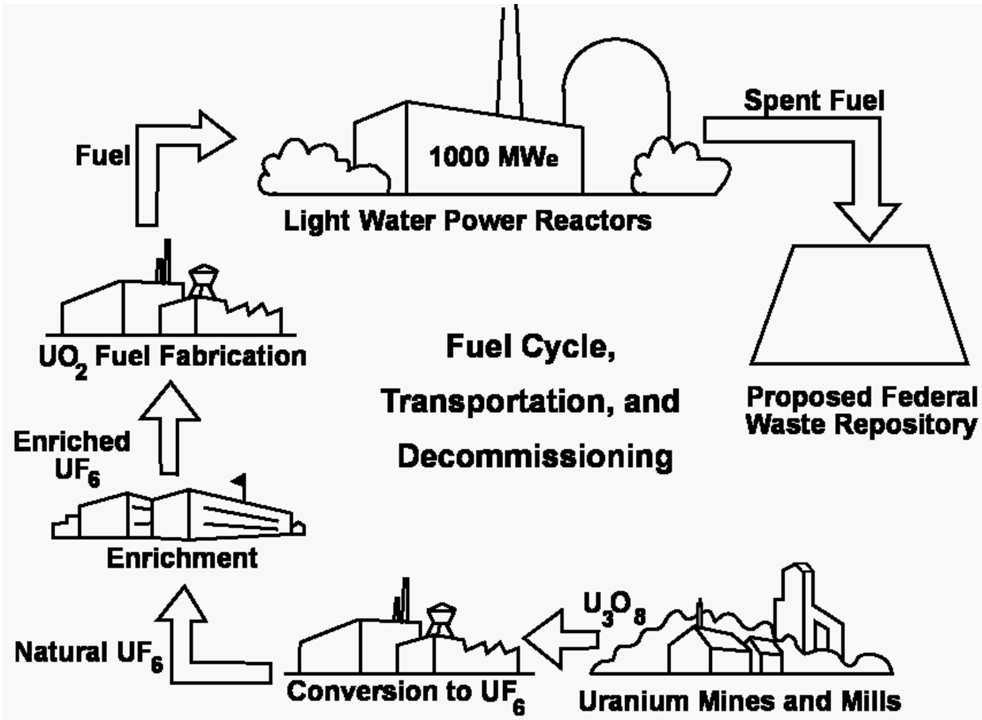

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1996)

considered here uses the same type of fuel; the staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and provided here. The fuel-cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). In the following review and evaluation of the environmental impacts of the fuel cycle, the NRC staff considered the capacity factor of 93 percent with a total net electric output of 1037 MW(e) for each of the proposed Units 1 and 2 at the LNP site for a total of 2074 MW(e) (PEF 2009a). This is about 2.6 times (i.e., 2074 MW[e] divided by 800 MW[e] yields 2.6) the impact values in Table S–3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1000-MW(e) LWR-scaled model, 2074 MW(e) for the site.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel-cycle impacts are below those identified in Table S–3. This is especially true in light of the following recent fuel cycle trends in the United States:

- Increasing use of in situ leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifuge. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion.
- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent-fuel assemblies per reactor-year are discharged; hence, the waste storage/repository impact is less.

The values in Table S–3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the NRC staff used an approach of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel-cycle parameters and interactions were recognized by the NRC staff as being less precise than the estimates and were not considered or were considered but had no effect on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S–3, the NRC staff defined the model reactor as a 1000-MW(e) LWR operating at 80-percent capacity with a 12-month fuel-reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reactor reference year" or "reference reactor-year" depending on the source (either Table S–3 or NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the now more likely 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This was done in NUREG-1437 for both boiling water reactors and pressurized water reactors; the higher annual requirement, 35 MT of uranium made into fuel for a boiling water reactor, was chosen in NUREG-1437 as the basis for the reference reactor-year (NRC 1996). A number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since Table S–3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored use of foreign uranium at the expense of the domestic uranium industry. These market conditions resulted in the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, there is some renewed interest in uranium mining and milling in the United States and the NRC recently received multiple license applications for uranium mining and milling. The majority of these applications are for in situ leach-solution mining that does not produce tailings. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S–3; however, Table S–3 estimates have not been reduced for these analyses.

Section 6.2 of NUREG-1437 (NRC 1996) discusses the sensitivity to recent changes in the fuel cycle on the environmental impacts in greater detail.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model would be about 294 ac. Of this land requirement, approximately 34 ac would be permanently committed land, and 260 ac would be temporarily committed. A “temporary” land commitment is a commitment for the life of the specific fuel-cycle plant (e.g., a mill, enrichment plant, or succeeding plants). After completion of decommissioning, such land can be released for unrestricted use. “Permanent” commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E, for release of that area for unrestricted use. Of the 260 ac of temporarily committed land, 205 ac are undisturbed and 55 ac are disturbed. In comparison, a coal-fired power plant using the same megawatt-electric output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 520 ac/yr for fuel alone. The NRC staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model would be that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S–3, of the total annual water use of 29,600 million gallons, about 28,800 million gallons are required for the removal of waste heat. Also scaling from Table S–3, other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 416 million gallons per year and discharge to the ground (e.g., mine drainage) of about 330 million gallons per year.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are less than 5 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The maximum consumptive water use of 29,600 million gallons per year (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be less than 4 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The NRC staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil-Fuel Impacts

Electric energy and process heat are required during various phases of the fuel-cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents less than 4 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant.

The largest source of carbon dioxide (CO_2) emissions associated with nuclear power is from the fuel cycle, not the operation of the plant, as indicated above and in Table S–3. The CO_2 emissions from the fuel cycle are less than 4 percent of the CO_2 emissions from an equivalent fossil-fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas-centrifuge technology is likely to eventually replace gaseous-diffusion technology for uranium enrichment in the United States. The same amount of enrichment from a gas-centrifuge facility uses less electricity and therefore results in lower amounts of air emissions such as carbon dioxide than a gaseous-diffusion facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

In Appendix I, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000-MW(e) LWR for a 40-year plant life is on the order of 1.8×10^7 MT of CO_2 including a small contribution from other greenhouse gases. Scaling this footprint to the power level and capacity factor of LNP Units 1 and 2, the NRC staff estimates the carbon footprint for 40 years of fuel cycle emissions to be about 4.7×10^7 MT of CO_2. This rate of CO_2 production equals 1.2×10^6 MT of CO_2 per year, less than 0.05 percent of the 2.36×10^9 MT of CO_2 production from electricity generation in the United States in 2008 (EPA 2010).

On this basis, the NRC staff concludes that the fossil fuel impacts, including greenhouse gas emissions, from the direct and indirect consumption of electric energy for fuel-cycle operations would be SMALL.

6.1.4 Chemical Effluents

The quantities of gaseous and particulate chemical effluents produced in fuel-cycle processes are given in Table S–3 (Table 6-1) for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table S–3 states that the fuel cycle for the reference 1000-MW(e) LWR requires 323,000 MWh of electricity. The fuel cycle for the 1000-MW(e) LWR-scaled model would therefore require 840,000 MWh of electricity, or 0.02 percent of the 4.1 billion MWh of electricity generated in the United States in 2008 (DOE 2009). Therefore, the gaseous and particulate chemical effluents would add about 0.02 percent to the national gaseous and particulate chemical effluents from electricity generation.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S–3 (Table 6-1) specifies the amount of dilution water required for specific constituents. In addition, all liquid discharges into the navigable waters of the United States from plants associated with fuel-cycle operations would be subject to requirements and limitations set by an appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process, but as Table S–3 indicates, effluents are not released in quantities sufficient to have a significant impact on the environment.

Based on the above analysis, the NRC staff concludes that the impacts of these gaseous, particulate, and liquid chemical effluents would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste-management activities and certain other phases of the fuel-cycle process are set forth in Table S–3 (Table 6-1). Using these effluents in NUREG-1437 (NRC 1996), the NRC staff calculated the 100-year environmental dose commitment to the U.S. population from the fuel cycle of 1 year of operation of the model 1000-MW(e) LWR. The total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle (excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99) were calculated to be approximately 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 2.6 for the 1000-MW(e) LWR-scaled model would result in whole body dose commitment estimates of 1040 person-rem for gaseous releases and 520 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1600 person-rem for the 1000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. PEF provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (PEF 2009a). PEF's evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operation of the reference 1000-MW(e) LWR. The estimated release of radon-222 for the reference reactor-year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for the site for a year, is approximately 13,500 Ci. Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the NRC staff assumed that the LWR-scaled model would result in an emission of 2.6 Ci per site year (i.e., about 2.6 times the NUREG-1437 (NRC 1996) estimate for the reference reactor-year). The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 Subpart C were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from radon from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 2400 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 47 person-rem to the whole body. Additional insights regarding Federal policy/resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996).

Also as discussed in NUREG-1437, the NRC staff considered the potential doses associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor-year for the 1000-MW(e) LWR-scaled model are 0.018 Ci from chemical processing of recycled uranium hexafluoride before it enters the isotope-enrichment cascade and 0.013 Ci into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose-weighting factors from 10 CFR Part 20 Subpart C to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 260 person-rem for the 1000-MW(e) LWR-scaled model.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect, and that the risk is higher for higher radiation exposures. Therefore, a linear, no threshold dose response relationship assumption is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This nominal probability coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem, equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection (ICRP) Publication 103 (ICRP 2007).

The nominal probability coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 4300 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 2.5 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 1 km in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR 190.10, is 25 mrem/yr to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel-cycle facilities in operation in the United States in 1981. The report found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990). The contribution to the annual average dose received by an individual from fuel-cycle-related radiation and other sources as reported in a report published by the National Council on Radiation Protection and Measurements (NCRP) (NCRP 2009) is listed in Table 6-2. The nuclear fuel-cycle contribution to an individual's annual average radiation dose is extremely small (less than 1 mrem/yr) compared to the annual average background radiation dose (about 311 mrem/yr).

Based on the analyses presented above, the NRC staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are SMALL.

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S–3 (Table 6-1). For low-level waste (LLW) disposal at land burial facilities, the Commission notes in Table S–3 that there would be no significant radioactive releases to the environment.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

Source		Dose (mrem/yr)[a]	Percent of Total
Ubiquitous background	Radon and thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	311	50
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	300	48
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[b]	0.1
	Nuclear fuel cycle	0.05[c]	0.01
Total		624	

Source: NCRP 2009; Report 160, *Ionizing Radiation Exposure of the Population of the United States*
(a) NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Calculated using 153 person-Sv/yr from Table 6.1 of NCRP 160 and a 2006 U.S. population of 300 million.

The Barnwell LLW disposal facility in Barnwell, South Carolina, no longer accepts Class B and C wastes from sources in states outside of the Atlantic Compact, so LNP would not be able to dispose of these wastes at Barnwell.

By the time LNP Units 1 and 2 would begin operation, PEF expects to have entered into an agreement with an NRC-licensed facility that would accept LLW from LNP. If PEF has not entered into an agreement with an NRC-licensed facility that would accept LLW from LNP, PEF would implement measures to reduce or eliminate the generation of Class B and C wastes, extending the capacity of the onsite waste storage to more than 2 years (PEF 2009b). If needed, PEF would also construct additional storage facilities onsite and has indicated (PEF 2009b) that such facilities would be designed and operated to meet the guidance in Appendix 11.4-A of the Standard Review Plan, NUREG-0800 (NRC 2007). Finally, PEF could enter into an agreement with a third party contractor to process, store, own, and ultimately dispose of LLW from LNP. Because PEF will have to choose one or a combination of these three options, the staff considered the environmental impacts of each of these three options.

Table S–3 addresses the environmental impacts if PEF enters into an agreement with an NRC-licensed facility for disposal of LLW, and Table S–4 addresses the environmental impacts from transportation of LLW as discussed in Section 6.2. The use of third-party contractors was not explicitly addressed in Tables S–3 and S–4; however, such third-party contractors are already licensed by the NRC and currently operate in the United States. Experience from the operation of these facilities shows that the additional environmental impacts are not significant compared to the impacts described in Tables S–3 and S–4.

The measures to reduce the generation of Class B and C wastes described by PEF, such as reducing the service run length of resin beds, could increase the volume of LLW, but would not increase the total curies of radioactive material in the waste. The volume of waste would still be bounded by or similar to the estimates in Table S–3, and the environmental impacts would not be significantly different.

In most circumstances, the NRC's regulations (10 CFR 50.59) allow licensees operating nuclear power plants to construct and operate additional onsite LLW storage facilities without seeking approval from the NRC. Licensees are required to evaluate the safety and environmental impacts before constructing the facility and make those evaluations available to NRC inspectors. A number of nuclear power plant licensees have constructed and operate such facilities in the United States. Typically, these additional facilities are constructed near the powerblock inside the security fence on land that has already been disturbed during initial plant construction. Therefore, the impacts on environmental resources (e.g., land use and aquatic and terrestrial biota) would be very small. All of the NRC (10 CFR Part 20) and EPA (40 CFR Part 190) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate additional onsite LLW facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be below 25 mrem/yr, the dose limit of 40 CFR Part 190. The NRC staff concludes that doses to members of the public within the NRC and EPA regulations are a small impact. In addition, NUREG-1437 assessed the impacts of LLW storage onsite at currently operating nuclear power plants and concluded that the radiation doses to offsite individuals from interim LLW storage are insignificant (NRC 1996). The types and amounts of LLW generated by the proposed reactors at LNP would be similar to those generated by currently operating nuclear power plants and the construction and operation of any interim LLW storage facilities would be similar to the construction and operation of the currently operating facilities. Therefore, the impacts of constructing and operating additional onsite LLW storage facilities would be small.

In 10 CFR 51.23, the Commission notes that high-level and transuranic wastes are to be buried at a repository, such as the candidate repository at Yucca Mountain, Nevada. The Commission also notes that no release to the environment is expected to be associated with such disposal, because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the high-level and transuranic

Table S–3 values established by the Commission, the NRC staff indicates that these high-level and transuranic wastes would be buried and would not be released to the environment.

As part of the Table S–3 rulemaking, the staff evaluated, along with more conservative assumptions, the zero-release assumption associated with waste burial in a repository, and the NRC reached an overall generic determination that fuel-cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC's position that the zero-release assumption was reasonable in the context of the Table S–3 rulemaking to address generically the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas & Electric v. NRDC (1983)).

Furthermore, in the Commission's Waste Confidence Decision, 10 CFR 51.23, the Commission has made the generic determination that "if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation […] of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations." That regulation also states that "the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such a reactor and generated up to that time." The regulation provides that, accordingly, no discussion of any environmental impact of spent fuel storage for the period following the term of the combined license is required in any environmental impact statement (EIS) prepared in connection with the issuance of that combined license.

In October 2008, the Commission proposed a rulemaking to update and revise the Waste Confidence Decision (73 FR 59551). Public comments were received on the rulemaking, and the public comment period for the rule was extended through February 2009 (73 FR 72370). At this time, however, the Commission has not approved the publication of a final rule. If a revised rule concerning the waste confidence determination is ultimately issued by the Commission, the staff will be required to follow that determination. Absent further developments with respect to the Waste Confidence rulemaking, Table S–3 and the existing Waste Confidence Decision indicate that any environmental impacts associated with the high-level waste that would be generated by the LNP Units 1 and 2 would be minimal.

In the context of operating license renewal, Sections 6.2 and 6.4 of NUREG-1437 (NRC 1996) provide additional description of the generation, storage, and ultimate disposal of LLW, mixed waste, and spent fuel from power reactors, concluding that environmental impacts from these activities are small. For the reasons stated above, the NRC staff concludes that the environmental impacts of radioactive waste storage and disposal associated with LNP Units 1 and 2 would be SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 1560 person-rem. This is based on a 600 person-rem occupational dose estimate attributable to all phases of the fuel cycle for the model 1000-MW(e) LWR (NRC 1996). The environmental impact from this occupational dose is considered SMALL because the dose to any individual worker would be maintained within the limits of 10 CFR Part 20 Subpart C, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public totals about 2.5 person-rem annually for the reference 1000-MW(e) LWR, according to Table S–3 (Table 6-1). This corresponds to a dose of 3.2 person-rem for the 1000-MW(e) LWR-scaled model (PEF 2009a) and 6.5 person-rem for two proposed AP1000 reactors located at the LNP site. For purposes of comparison, the estimated collective dose from natural background radiation to the current population within 50 mi of the LNP site in 2005 is about 400,000 person-rem/yr (PEF 2009a). Based on this comparison, the NRC staff concludes that environmental impacts of transportation would be SMALL.

6.1.9 Conclusions for Fuel Cycle and Solid-Waste Management

The NRC staff evaluated the environmental impacts of the uranium fuel cycle, as given in Table S–3 (Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of greenhouse gas emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on these evaluations, the NRC staff concludes that the impacts of the uranium fuel cycle would be SMALL.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the LNP site and alternative sites, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain, Nevada, site as a surrogate destination for a permanent repository. The impacts evaluated in this section for two new nuclear generating units at the LNP site are appropriate to characterize the alternative sites discussed in Section 9.3 of this EIS. Alternative sites evaluated in this EIS include the LNP site (proposed), and alternative sites at Crystal River, Dixie, Highlands, and Putnam. There is no meaningful differentiation among the proposed and the alternative sites regarding the radiological and nonradiological environmental impacts from normal operating and accident conditions and these conditions are not discussed further in Chapter 9.

NRC performed a generic analysis of the environmental effects of the transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC 1975), and found the impact to be small. These documents provided the basis for Table S–4 in 10 CFR 51.52 that summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW[e]). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR.[(a)] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor-year. The combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 3 person-rem per reference reactor-year.

Environmental risks of radiological effects during accident conditions, as stated in Table S–4, are SMALL. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reference reactor-years and one nonfatal injury in 10 reference reactor-years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and NUREG/CR-6672 (Sprung et al. 2000) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed to be bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level that does not exceed 3800 MW(t).
- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and pellets are encapsulated in zircalloy-clad fuel rods.
- The average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.

(a) The transportation impacts associated with the LNP site were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparisons to Table S–4. Note that the basis for Table S–4 is an 1100 MW(e) LWR at an 80-percent capacity factor (AEC 1972; NRC 1975). The basis for Table S–3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is a 1000 MW(e) LWR with an 80-percent capacity factor (NRC 1976). However, because fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, railcar, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or railcar.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities are resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis, for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 weight percent uranium-235), or thermal power levels (above 3800 MW[t]). Departures from the conditions itemized in 10 CFR 51.52(a) are to be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing of new reactors.

In its application, PEF requested combined construction permits and operating licenses (COLs) for two proposed reactors at its LNP site in Florida. Both proposed new reactors would be Westinghouse AP1000 advanced LWRs. The Westinghouse AP1000 reactor has a thermal power rating of 3400 MW(t), with a minimum net electrical output of 1115 MW(e). The Westinghouse AP1000 reactors are expected to operate with a 93-percent capacity factor, yielding a net electrical output (annualized) of about 1037 MW(e). Fuel for the units would be enriched up to about 4.51 weight percent uranium-235, which exceeds the 4-percent condition given in 10 CFR 51.52(a). In addition, the expected peak irradiation level of about 62,000 MWd/MTU exceeds the 33,000 MWd/MTU condition given in 10 CFR 51.52(a). Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (PEF 2009a), PEF provided a full description and detailed analyses of transportation impacts. In these analyses, the radiological impacts of transporting fuel and waste to and from the proposed LNP site and alternative sites were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2006). RADTRAN 5.6 was used in this EIS and is the most commonly used transportation impact analysis software in the nuclear industry.

Comments on four previous early site permit EISs also were considered when developing the scope of this EIS. The most significant change is that this EIS includes an explicit analysis of the nonradiological impacts of transporting unirradiated fuel, spent fuel, and radioactive waste to and from the LNP site and alternative sites. Nonradiological impacts of transporting construction workers and materials (see Section 4.8.3) and operations workers (Section 5.8.6) are addressed elsewhere in this EIS. Publicly available information about traffic accident, injury, and fatality rates was used to estimate nonradiological impacts. In addition, the radiological impacts on maximally exposed individuals (MEIs) are evaluated.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent evaluation of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the LNP site and alternative sites. Radiological impacts of normal conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts on populations and MEIs are presented. Because the specific fuel fabrication plant for LNP unirradiated fuel is not known at this time, the NRC staff's analysis assumes a "representative" route between the fuel fabrication facility and LNP site and alternative sites. This means that there are no substantive differences between the impacts calculated, for the purposes of Chapter 9, for the LNP site and the four alternative sites. The site-specific differences are minor because the radiation doses from unirradiated fuel transport are minute and the differences in shipping distances between potential fuel fabrication plants and the LNP site and alternative sites are small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities during which shipments reach their destination without releasing any radioactive material to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping containers. Radiation exposures at some level would occur to the following individuals: (1) persons residing along the transportation corridors between the fuel fabrication facility and the LNP or alternative sites; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides an estimate of the number of truck shipments of unirradiated fuel for the Westinghouse AP1000 reactor design compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80-percent capacity (880 MW[e]). After normalization, the NRC staff found that the number of truck shipments of unirradiated fuel to the LNP site or alternative sites would be fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238. The results are consistent with the estimates provided in PEF's ER (PEF 2009a).

Shipping Mode and Weight Limits

In 10 CFR 51.52, a condition is identified that states all unirradiated fuel is shipped to the reactor by truck. PEF specifies that unirradiated fuel would be shipped to the proposed reactor site by truck. Section 10 CFR 51.52, Table S–4, includes a condition that the truck shipments not exceed 73,000 lb as governed by Federal or State gross vehicle weight restrictions. PEF states in its ER that the unirradiated fuel shipments to the LNP site and alternative sites would comply with applicable weight restrictions (PEF 2009a).

Table 6-3. Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and a Single AP1000 Reactor at the LNP Site

Reactor Type	Number of Shipments per Reactor Unit			Unit Electric Generation, MW(e)[(c)]	Capacity Factor[(c)]	Normalized, Shipments per 1100 MW(e)[(d)]
	Initial Core[(a)]	Annual Reload	Total[(b)]			
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
LNP Westinghouse AP1000	23	5.4	233	1115	0.93	198

(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from WASH-1238 for the reference LWR and from the ER (PEF 2009a) for the Westinghouse AP1000 reactor.
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW[e] plant at an 80-percent or net electrical output of 880 MW[e]).

Radiological Doses to Transport Workers and the Public

Section 10 CFR 51.52, Table S–4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and the number of shipments to which the individuals are exposed. For this EIS, the radiological dose impacts of the transportation of unirradiated fuel were calculated by the NRC staff for the worker and the public using the RADTRAN 5.6 computer code (Weiner et al. 2006).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 3.3 ft from the transport vehicle is about 0.1 mrem/hr. This assumption also was used in the NRC staff's analysis of the Westinghouse AP1000 reactor unirradiated fuel shipments. This assumption is reasonable because the Westinghouse AP1000 reactor fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to those described in WASH-1238 (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of reactor operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

Table 6-4. RADTRAN 5.6 Input Parameters for Reference LWR Fresh Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3200	AEC 1972[a]
Travel fraction – Rural	0.90	Rural, suburban, and urban travel fractions are taken from NRC (1977a).
Travel fraction – Suburban	0.05	
Travel fraction – Urban	0.05	
Population density – Rural, persons/km^2	10	Rural, suburban, and urban population densities are taken from DOE (2002a).
Population density – Suburban, persons/km^2	349	
Population density – Urban, persons/km^2	2260	
Vehicle speed – km/hr	88.49	Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	530	Rural, suburban, and urban traffic counts are taken from DOE (2002a).
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC 1972
Packaging length, m	7.3	Approximate length of two LWR fuel element packages placed on end (DOE 1997).
Number of truck crew	2	AEC 1972, NRC 1977a, and DOE 2002a
Stop time, hr/trip	4	Based on one 30-minute stop per 4-hour driving time.
Population density at stops, persons/km^2	See Table 6- for truck stop parameters	

(a) AEC 1972 provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for unirradiated fuel shipments. A 3200-km (2000-mi) “representative” shipping distance was assumed here.

The RADTRAN 5.6 results for this “generic” unirradiated fuel shipment are as follows:

- worker dose: 1.71×10^{-3} person-rem/shipment
- general public dose (onlookers/persons at stops and sharing the highway): 2.91×10^{-3} person-rem/shipment
- general public dose (along route/persons living near a highway or truck stop): 4.12×10^{-5} person-rem/shipment.

These values were combined with the average annual shipments of unirradiated fuel for the Westinghouse AP1000 reactor to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts on workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 0.5 mi of the highway) for transporting unirradiated fuel to the LNP site and alternative sites for a single AP1000 reactor.

Table 6-5. Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the LNP Site or Alternative Sites for a Single AP1000 Reactor

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-rem/yr per 1100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238)	6.3	1.1×10^{-2}	1.8×10^{-2}	2.6×10^{-4}
Reference Westinghouse AP1000	5.0	8.5×10^{-3}	1.4×10^{-2}	2.0×10^{-4}
LNP	5.0	3.1×10^{-3}	7.6×10^{-3}	2.9×10^{-4}
Crystal River	5.0	3.1×10^{-3}	7.6×10^{-3}	2.9×10^{-4}
Dixie	5.0	3.0×10^{-3}	7.5×10^{-3}	2.5×10^{-4}
Highlands	5.0	3.6×10^{-3}	1.1×10^{-2}	3.5×10^{-4}
Putnam	5.0	2.7×10^{-3}	7.4×10^{-3}	2.6×10^{-4}
10 CFR 51.52, Table S–4 Condition	<1 per day	4.0×10^{0}	3.0×10^{0}	3.0×10^{0}

(a) Divide person-rem/yr by 100 to obtain doses in person-Sv/yr.

The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) (880 MW[e] net electrical output). The NRC staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr to onlookers, and 3 person-rem/yr to members of the public along the route.

In its ER (PEF 2009a), PEF assumed that unirradiated fuel would be shipped from a fuel fabrication facility located near Lynchburg, Virginia, rather than the “generic” location assumed in WASH-1238. The NRC staff evaluated PEF’s analysis by attempting to duplicate a sample of the impact calculations. RADTRAN 5.6 calculations were performed using the route information and other input parameters specified in the ER. No significant differences were identified. Based on this confirmatory analysis, the NRC staff concluded that PEF’s analysis of unirradiated fuel transportation impacts is sufficient to meet the requirements of 10 CFR 51.52(b).

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from ICRP Publication 103 (ICRP 2007).

Both the NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the LNP site and alternative sites was less than 2×10^{-2} person-rem, which is less than the 1754 person-rem value that ICRP and NCRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives about 311 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 2009). Using this average effective dose, the collective population dose from natural background radiation to the population along the generic representative route would be about 2.2×10^{5} person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the LNP site and alternative sites are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

Maximally Exposed Individuals Under Normal Transport Conditions

A scenario-based analysis was conducted by the NRC staff to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the LNP site and alternative sites. The following discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive waste shipments from, the LNP and any of the alternative sites. The analysis is based on data from DOE (2002b) and incorporates data about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the normalized fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 2 m (6.6 ft) from the side of the transport vehicle. This assumption is conservative, in that the assumed dose rate is the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations (49 CFR 173.441). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972; DOE 2002a). An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the LNP site and alternative sites. The analysis of MEIs is described below.

Truck Crew Member

Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period. The analysis assumed that crew member doses are limited to 2 rem/yr, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005). The NRC staff anticipates this limit would apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. There would be more shipments of spent nuclear fuel from the LNP site (or alternative sites) than there would be shipments of unirradiated fuel to and radioactive waste other than spent fuel from, these sites. This is because the capacities of spent fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002a). As a result, crew doses from unirradiated fuel and radioactive waste shipments would be lower than the doses from spent nuclear fuel shipments. The DOE administrative limit of 2 rem/yr (DOE 2005) is less than the NRC limit for occupational exposures of 5 rem/yr (see 10 CFR Part 20).

The U.S. DOT does not regulate annual occupational exposures. It does recognize that air crews are exposed to elevated cosmic radiation levels and recommends dose limits to air crew members from cosmic radiation (DOT 2003). Air passengers are less of a concern because they do not fly as frequently as air crew members. The recommended limits are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003). As a result of this recommendation, a 2-rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the LNP site and alternative sites.

Inspectors

Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. The Yucca Mountain Final EIS (DOE 2002a) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. Assuming conservatively that the external dose rate at 2 m (6.6 ft) is at the maximum allowed by regulations (10 mrem/hr), the dose rate at 1 m (3.3 ft) is about 14 mrem/hr (Weiner et al. 2006). Therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative external dose rate and the assumption that the same person inspects all shipments of fuel and waste to and from the LNP site and alternative sites, the annual doses to vehicle inspectors were calculated to be about 0.9 rem/yr, based on a combined total of 66 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is about one-half of the 2-rem/yr DOE administrative control level on individual doses (DOE 2005) and one-fifth of the 5-rem/yr NRC occupational dose limit (see 10 CFR Part 20).

Doses to State inspectors would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites, which would bring their annual dose to approximately the DOE administrative limit.

Residents

The analysis assumed that a resident lives adjacent to a highway where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were obtained from the NRC staff's RADTRAN 5.6 output files. These dose estimates are based on an individual located 100 ft from the shipments that are traveling 15 mph. The potential radiation dose to the maximally exposed resident is about 0.043 mrem/yr for shipments of fuel and waste to and from the LNP site and alternative sites with a single AP1000 reactor. This dose would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites.

Individuals Stuck in Traffic

This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hour at a distance of 4 ft. The NRC staff's analysis assumed this exposure scenario would occur only one time to any individual, and the dose rate was at the regulatory limit of 10 mrem/hr at 2 m (6.6 ft) from the shipment, so the dose rate would be higher at the assumed exposure distance of 4 ft. The dose to the MEI was calculated to be 16 mrem in DOE's Yucca Mountain Final EIS (DOE 2002b). These doses would not be doubled for a site with two Westinghouse AP1000 reactors, because it was assumed that this scenario would occur only once to any individual.

Persons at a Truck Service Station

This scenario estimates doses to an employee at a service station where all truck shipments to and from the LNP site and alternative sites are assumed to stop. The NRC staff's analysis assumed this person is exposed for 49 minutes at a distance of 52 ft from the loaded shipping container (DOE 2002b). The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of about 0.34 mrem/shipment and an annual dose of about 22 mrem/yr for the LNP site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the LNP site and alternative sites with a single AP1000 reactor. This dose would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the LNP site and alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for

Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security, and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference in the consequences of transportation accidents severe enough to result in a release of unirradiated fuel particles to the environment between the Westinghouse AP1000 and current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, consistent with the conclusions of WASH-1238 (AEC 1972), the impacts of accidents during transport of unirradiated fuel to a Westinghouse AP1000 reactor at the LNP site and alternative sites are expected to be negligible.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the LNP site and alternative sites; that is, the analysis does not consider the radiological or hazardous characteristics of the cargo. Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is as follows:

Impacts = (unit rate) × (round-trip shipping distance) × (annual number of shipments).

In this formula, impacts are presented in units of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in ANL/ESD/TM-150 *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for truck shipments similar to those to be used to transport unirradiated fuel to the LNP site and alternative sites. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 percent and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting.

The nonradiological accident impacts for transporting unirradiated fuel to (and empty shipping containers from) the LNP site and alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR are also shown for comparison purposes. Note that there are only small differences between the impacts calculated for an AP1000 reactor at the LNP site and alternative sites and the reference LWR in WASH-1238 due entirely to the estimated annual number of shipments. Overall, the impacts are minimal and there are no substantive differences among the LNP site and alternative sites. The impacts would be doubled for a site with two AP1000 reactors like the LNP site and the alternative sites.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the LNP Site and Alternative Sites with a Single AP1000 Reactor, Normalized to Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance (km)	Annual Round-trip Distance (km)	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (AEC 1972)	6.3	3200	4.0×10^{4}	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
Reference Westinghouse AP1000	5.0	3200	3.2×10^{4}	1.5×10^{-2}	7.3×10^{-3}	4.6×10^{-4}
LNP	5.0	1166	1.2×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Crystal River	5.0	1152	1.1×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Dixie	5.0	1131	1.1×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Highlands	5.0	1349	1.3×10^{4}	7.1×10^{-3}	3.9×10^{-3}	3.3×10^{-4}
Putnam	5.0	1020	1.0×10^{4}	6.7×10^{-3}	3.7×10^{-3}	2.9×10^{-4}

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the LNP site and alternative sites to a spent fuel disposal repository. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain site in Nevada as a surrogate destination. Currently, NRC has not made a decision on the proposed geologic repository at Yucca Mountain. However, the NRC staff considers that an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts on a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological and nonradiological environmental impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts, are discussed in this section.

This NRC staff's analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Due to the large size and weight of spent fuel shipping casks, each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with those made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). Because the alternative transportation methods involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999), thereby reducing impacts, these assumptions are conservative. Also, the use of current shipping cask designs for this analysis results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (greater than 5 years out of reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thus reducing the numbers of shipments and associated impacts.

Radiological impacts of transportation of spent fuel were calculated by the NRC staff using the RADTRAN 5.6 computer code (Weiner et al. 2006). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2003). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS (Johnson and Michelhaugh 2003). Traffic accident rates input to RADTRAN 5.6 and nonradiological impact calculations were adjusted to account for under-reporting, as discussed in Sections 4.8.3 and 6.2.1.3.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without an accident occurring en route. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation exposures would occur to the following populations: (1) persons residing along the transportation corridors between the LNP site and alternative sites and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers (drivers). For purposes of this analysis, it was assumed that the destination for the spent fuel shipments is the proposed Yucca Mountain disposal facility in Nevada. This assumption is conservative, because it tends to maximize the shipping distance from the LNP site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the Westinghouse AP1000. Information in the *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, current shipping cask designs were used for the analysis of Westinghouse AP1000 reactor spent fuel shipments. The NRC staff assumed that the capacity of a truck shipment of Westinghouse AP1000 reactor spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972). In its ER (PEF 2009a), PEF assumed a shipping cask capacity of 0.5 MTU/shipment.

Input to RADTRAN 5.6 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2003) for highway routes from the LNP site and alternative sites to the proposed Yucca Mountain facility. The resulting route characteristics information is shown in Table 6-7. Note that for truck shipments, all of the spent fuel is assumed to be shipped to the proposed Yucca Mountain facility over designated highway-route controlled quantity routes. In addition, TRAGIS data were used in RADTRAN 5.6 on a state-by-state basis. This increases precision and could allow the results to be presented for each state along the route between the LNP site and alternative sites and Yucca Mountain.

Table 6-7. Transportation Route Information for Shipments from the LNP Site and Alternative Sites to the Yucca Mountain Spent Fuel Disposal Facility[(a)]

	One-Way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
Reactor Site	**Total**	**Rural**	**Suburban**	**Urban**	**Rural**	**Suburban**	**Urban**	
Levy County	4520.3	3479.8	935.2	105.4	9.9	318.5	2271.4	5.5
Crystal River	4506.5	3466.0	935.2	105.4	9.9	318.5	2271.4	5.5
Dixie	4407.8	3439.6	866.5	101.9	9.8	320.3	2268.2	5.5
Highlands	4867.9	3745.7	1005.0	117.4	9.9	327.6	2243.6	6.0
Putnam	4529.9	3504.3	915.2	110.6	9.8	327.0	2259.1	5.5

Source: Johnson and Michelhaugh 2003
(a) This table presents aggregated route characteristics given in the TRAGIS (Johnson and Michelhaugh 2003), including estimated distances from the LNP and alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number in the truck crew, stop time, and population density at stops. A list of the values for these and other parameters and the sources of the information is provided in Table 6-8.

Table 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on the average speed in rural areas given in DOE (2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	State-specific	State-specific rural, suburban, and urban traffic counts are taken from Weiner et al. (2006)
Traffic count – Suburban, vehicles/hr	State-specific	
Traffic count – Urban, vehicles/hr	State-specific	
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, b) – approximate dose rate at 1 m that is equivalent to the maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle.
Packaging dimensions, m	Length – 5.82 Diameter – 1.0	DOE (2002b)
Packaging dimensions, m	Length – 5.82 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a, b)
Stop time, hr/trip	Route-Specific	See Table 6-5
Population density at stops, persons/km^2	30,000	Sprung et al. (2000). Nine persons within 10 m of vehicle. See Figure 6-2.
Min/max radii of annular area around vehicle at stops, m	1 to 10	Sprung et al. (2000)
Shielding factor applied to annular area surrounding vehicle at stops, dimensionless	1 (no shielding)	Sprung et al. (2000)
Population density surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. (2000)
Shielding factor applied to annular area surrounding truck stop, dimensionless	0.2	Sprung et al. (2000)

For the purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escort vehicles and drivers were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers and would be negligible (DOE 2002b). Stop times for refueling and rest were assumed to occur at the rate of

30 minutes per 4 hours of driving time. TRAGIS outputs were used to determine the number of stops. Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5.6 analyses. For this analysis, doses to the public at refueling and rest stops (“stop doses”) are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and it extends from 10 to 800 m from the vehicle. This scheme is similar to that used by Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

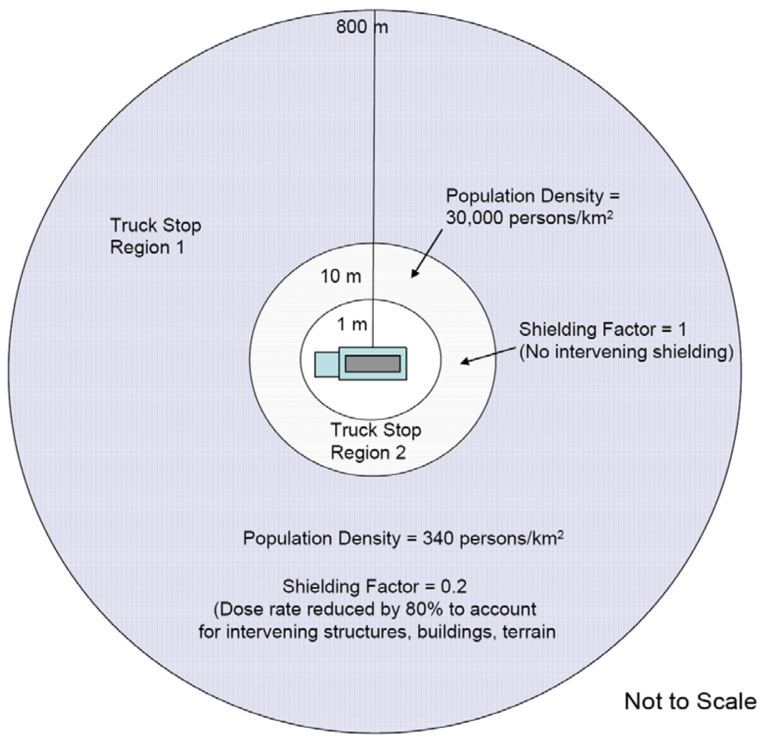

Figure 6-2. Illustration of Truck Stop Model

The results of these normal (incident-free) exposure calculations are shown in Table 6-9 for the LNP site and alternative sites. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent fuel shipment), and persons along the route (persons living near the highway).

Shipping schedules for spent fuel generated by the proposed new units have not been determined. The NRC staff determined that it is reasonable to calculate annual doses assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements.

Population doses were normalized to the reference LWR in WASH-1238 (880 net MW[e]). This corresponds to an 1100-MW(e) LWR operating at 80-percent capacity. Note that the impacts in Table 6-9 would be doubled for a site with two AP1000 reactors like the LNP site and the alternative sites.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the LNP Site and Alternative Sites to the Proposed High-Level Waste Repository at Yucca Mountain

	Normalized Impacts, Person-rem/yr[a]		
Site and Reactor Type	**Worker (Crew)**	**Onlookers**	**Along Route**
Reference LWR (WASH-1238)[b]	1.2×10^{1}	3.0×10^{1}	6.4×10^{-1}
Levy County AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.2×10^{-1}
Crystal River AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.2×10^{-1}
Dixie AP1000[c]	8.0×10^{0}	2.0×10^{1}	4.0×10^{-1}
Highlands AP1000[c]	8.9×10^{0}	2.2×10^{1}	4.7×10^{-1}
Putnam AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.3×10^{-1}
Table S–4 Condition	4×10^{0}	3×10^{0}	3×10^{0}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Based on 60 shipments per year.
(c) Based on 40 shipments per year after normalizing to the reference LWR.

The small differences in transportation impacts among the LNP site and four alternative sites evaluated are not substantive and the differences among sites are relatively minor and are less than the uncertainty in the analytical results.

The bounding cumulative doses to the exposed population given in Table S–4 are as follows:

- 4 person-rem/reactor-year to transport workers
- 3 person-rem/reactor-year to general public (onlookers) and members of the public along the route.

The calculated population doses to the crew and onlookers for the reference LWR and the LNP and alternative site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 is the longer shipping distances assumed for this COL analysis (i.e., to a proposed repository in Nevada) than the distances used in WASH-1238 (AEC 1972). WASH-1238 assumed that each spent fuel shipment would travel a distance of 1000 mi, whereas the shipping distances used in this EIS were about 2700 mi to 3000 mi. If the shorter distance were used to calculate the impacts for the LNP and alternative sites spent fuel shipments, the doses would be reduced by about 60 percent. Other important differences are the stop model described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities on highways (vehicles per hour).

Where necessary, the NRC staff made conservative assumptions to calculate impacts associated with the transportation of spent fuel. Some of the key conservative assumptions are as follows:

- Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations. The shipping casks assumed in the EIS prepared by DOE in support of the application for a geologic repository at the proposed Yucca Mountain repository (DOE 2002b) would transport spent fuel that has cooled for a minimum of 5 years (see 10 CFR Part 961, Subpart B). Most spent fuel would have cooled for much longer than 5 years before it is shipped to a possible geologic repository. Based on this, shipments from the LNP site and alternative sites also are expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose rate projections are used.

- Use of the shipping cask capacity used in WASH-1238. The WASH-1238 analyses that form the basis for Table S–4 assumed that spent fuel would be shipped at least 90 days after discharge from a current LWR. The spent fuel shipping casks described in WASH-1238 were designed to transport 90-day-cooled fuel, so their shielding and containment designs must accommodate this highly radioactive cargo. Shipping-cask capacities assumed in WASH-1238 were approximately 0.5 MTU per truck cask. In the Yucca Mountain Supplemental EIS (DOE 2008), DOE assumed a 10-year cooling period for spent fuel to be shipped to the repository. This allowed DOE to increase the assumed shipping-cask capacity to about 1.8 MTU per truck shipment of un-canistered spent fuel. The NRC staff believes this is a reasonable projection for future spent fuel truck shipping cask capacities. If this assumption were to be used in this EIS, the number of shipments of spent fuel would be reduced by about one-third with a similar reduction in radiological incident-free impacts.

- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent fuel shipments are of short duration (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided by Griego et al. (1996) indicate that a 30-minute duration is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes. More realistic stop times would further reduce the population doses in Table 6-9.

A sensitivity study was performed by the NRC staff to demonstrate the effects of using more realistic dose rates and stop times on the incident-free population dose calculations. For this sensitivity study, the dose rate was reduced to 5 mrem/hr, the approximate 50-percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000) for future spent fuel shipments. The stop time was reduced to 18 minutes per stop. All other RADTRAN 5.6 input values were unchanged. The result is that the annual crew doses were reduced to 4.9 person-rem/yr, or about 60 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 5.3 person-rem/yr (about 27 percent) and the annual doses to persons along the route were reduced to 1.5×10^{-1} person-rem/yr (about 36 percent).

In its ER (PEF 2009a), PEF describes the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to Yucca Mountain. The PEF analysis and this EIS used similar methods and input parameters. The NRC staff concluded that the results produced by PEF are similar to those calculated by the NRC staff and reported in this EIS.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual public dose impacts for transporting spent fuel from the LNP or alternative sites to Yucca Mountain are about 22 person-rem, which is less than the 1754 person-rem value that ICRP (2007) and NCRP (1995) suggest would most likely result in no excess health effects. This dose is very small compared to the estimated 2.5×10^5 person-rem that the same population along the route from the LNP site to Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose along the LNP-to-Yucca-Mountain route from natural background radiation is different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route and actual highway routes were used in Section 6.2.1.1 for unirradiated fuel shipments and actual highway routes were used in this section for spent fuel shipments.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate the impacts of transportation accidents involving spent fuel shipments. RADTRAN 5.6 considers a spectrum of postulated transportation accidents, ranging from those with high frequencies and low consequences (e.g., “fender benders”) to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) and are the same as those presented in PEF’s ER (PEF 2009a). The Idaho National Engineering and Environmental Laboratory (INEEL) report (INEEL 2003) includes 140 radionuclides for Westinghouse AP1000 reactor spent fuel. The NRC staff conducted a screening analysis to select the dominant contributors to accident risks to simplify the RADTRAN 5.6 calculations. The screening identified the radionuclides that would contribute more than 99.999 percent of the dose from inhalation of radionuclides released following a transportation accident. Spent fuel inventories used in the NRC staff analysis are listed in Table 6-10.

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for the Westinghouse AP1000 Reactor[(a,b)]

Radionuclide	Ci/MTU	Bq/MTU
Pu-241	6.96×10^{4}	2.57×10^{15}
Pu-238	6.07×10^{3}	2.24×10^{14}
Cm-244	7.75×10^{3}	2.87×10^{14}
Am-241	7.27×10^{2}	2.69×10^{13}
Pu-240	5.43×10^{2}	2.01×10^{13}
Pu-239	2.55×10^{2}	9.44×10^{12}
Sr-90	6.19×10^{4}	2.29×10^{15}
Cs-137	9.31×10^{4}	3.44×10^{15}
Am-243	3.34×10^{1}	1.24×10^{12}
Cm-243	3.07×10^{1}	1.13×10^{12}
Am-242m	1.31×10^{1}	4.85×10^{11}
Ru-106	1.55×10^{4}	5.72×10^{14}
Eu-154	9.13×10^{3}	3.38×10^{14}
Cs-134	4.80×10^{4}	1.78×10^{15}
Ce-144	8.87×10^{3}	3.28×10^{14}
Sb-125	3.83×10^{3}	1.42×10^{14}
Pu-242	1.82×10^{0}	6.72×10^{10}
Cm-242	2.83×10^{1}	1.05×10^{12}
Pm-147	1.76×10^{4}	6.52×10^{14}
Cm-245	1.21×10^{0}	4.46×10^{10}
Y-90	6.19×10^{4}	2.29×10^{15}
Eu-155	4.62×10^{3}	1.71×10^{14}
Co-60[(b)]	1.20×10^{2}	4.40×10^{12}

Source: INEEL 2003 except where otherwise indicated.
(a) Divide becquerel/metric ton uranium (Bq/MTU) by 3.7×10^{10} to obtain curies/MTU.
(b) Cobalt-60 is the key radionuclide constituent of fuel assembly crud. The inventory was derived using data given by Sprung et al. (2000).

The list includes all of the radionuclides that were included in the analysis conducted by Sprung et al. (2000). However, INEEL (2003) did not provide radionuclide source terms for radioactive material deposited on the external surfaces of LWR spent fuel rods (commonly called "crud"). Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on Westinghouse AP1000 reactor spent fuel are not available at this time. The Westinghouse AP1000 reactor spent fuel transportation accident impacts were calculated by the NRC staff assuming that the cobalt-60 inventory in the form of crud is 4.4 TBq/MTU (120 Ci/MTU), based on information provided by Sprung et al. (2000). PEF also included the impacts of crud in its spent fuel transportation impact analysis (PEF 2009a).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe postulated accident conditions with essentially no loss of containment or shielding capability. These casks also are designed with fissile material controls to ensure that the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The NRC staff assumed that shipping casks approved for transportation of Westinghouse AP1000 reactor spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo.

Accident frequencies are calculated in RADTRAN 5.6 using user-specified accident rates and conditional shipping cask failure probabilities. State-specific accident rates were taken from Saricks and Tompkins (1999) and used in the RADTRAN 5.6 calculations. The state-specific accident rates were then adjusted to account for under-reporting, as described in Section 6.2.1.3. Conditional shipping cask failure probabilities (that is, the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000).

The RADTRAN 5.6 accident risk calculations were performed using the radionuclide inventories (Ci/MTU) in Table 6-10 multiplied by the shipping cask capacity (0.5 MTU). The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (shipments/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from the LNP site and alternative sites to the proposed repository at Yucca Mountain in Nevada. As was done for routine exposures, the NRC staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts from the Westinghouse AP1000 reactor spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

The NRC staff used RADTRAN 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways.[(a)] These pathways areas follows:

- external dose from exposure to the passing cloud of radioactive material (cloudshine).
- external dose from the radionuclides deposited on the ground by the passing plume (groundshine). The NRC staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.
- internal dose from inhalation of airborne radioactive contaminants (inhalation).
- internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The NRC staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

Table 6-11 presents the environmental consequences of transportation accidents when shipping spent fuel from the LNP site and alternative sites to the proposed Yucca Mountain repository. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (see Section 6.2.2.1). The results are normalized to the WASH-1238 reference reactor (880-MW[e] net electrical generation, 1100-MW[e] reactor operating at 80-percent capacity) to provide a common basis for comparison to the impacts listed in Table S–4. Although there are slight differences in impacts among alternative sites, none of the alternative sites would be clearly favored over the LNP site. The impacts would be doubled for two AP1000 reactors at the LNP site or alternative sites. The transportation accident impact analysis conducted by PEF (PEF 2009a) used methods and data that are similar to those used in this EIS. Differences are insignificant in terms of the overall results.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimate for transporting spent fuel from the LNP and alternative sites to Yucca Mountain is less than 1×10^{-4} person-rem, which is less than the 1754 person-rem value that ICRP (2007) and NCRP (1995) suggest would most likely result in zero excess health effects. The collective population dose from natural background radiation to the

(a) Internal dose from ingestion of contaminated food was not considered because the NRC staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

population along the representative routes from the LNP and alternative sites to Yucca Mountain would be about 2.5 × 10^5 person-rem. Therefore, the radiation doses from transporting spent fuel to Yucca Mountain are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an AP1000 Reactor at the LNP Site and Alternative Sites, Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

Site, Reactor Type	Normalized Population Impacts, Person-rem/yr[(a)]
Reference LWR (WASH-1238)[(b)]	1.4 × 10^{-4}
Levy County AP1000[(c)]	9.2 × 10^{-5}
Crystal River AP1000[(c)]	9.2 × 10^{-5}
Dixie AP1000[(c)]	9.1 × 10^{-5}
Highlands AP1000[(c)]	9.4 × 10^{-5}
Putnam AP1000[(c)]	9.2 × 10^{-5}

(a) Divide person-rem/yr by 100 to obtain person-Sv/yr.
(b) Based on 60 shipments per year.
(c) Based on 40 shipments per year after normalizing to the reference LWR.

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate the nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. State-by-state shipping distances were obtained from the TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by state from Saricks and Tompkins (1999) to calculate nonradiological impacts. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted to account for under-reporting (see Section 6.2.1.3). The results are shown in Table 6-12 for a single AP1000 reactor. The impacts would be doubled for a site with two AP1000 reactors like the LNP site and the alternative sites. Overall, the impacts are minimal and there are no substantive differences among the alternative sites.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the LNP Site and Alternative Sites to Yucca Mountain for a Single AP1000 Reactor, Normalized to Reference LWR

Site	One-Way Shipping Distance, km	Nonradiological Impacts, per year		
		Accidents	Injuries	Fatalities
Levy County	4520.3	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}
Crystal River	4506.5	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}
Dixie	4407.8	1.4×10^{-1}	8.7×10^{-2}	6.1×10^{-3}
Highland	4867.9	1.5×10^{-1}	8.9×10^{-2}	6.6×10^{-3}
Putnam	4529.9	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 40/yr after normalizing to the reference LWR.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste other than spent fuel from the LNP site and alternative sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or railcar.
- The weight limitation of 33,100 kg (73,000 lb) per truck and 90.7 MT (100 T) per cask per railcar would be met.
- Traffic density would be less than the condition of one truck shipment per day or three railcars per month.

Radioactive waste other than spent fuel from the Westinghouse AP1000 reactor is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents estimates of annual waste volumes and annual waste shipment numbers for a Westinghouse AP1000 reactor at the LNP site normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual waste volumes and waste shipments for the Westinghouse AP1000 reactor were less than the 1100-MW(e) reference reactor that was the basis for Table S–4. The maximum projected waste-generation rates for the Westinghouse AP1000 reactor (5717 ft^3 per year is the maximum estimated rate given by Westinghouse (2008) could exceed the reference LWR waste-generation rate. However, projections of the rate of waste generation are uncertain and are a function of PEF's radioactive waste-management practices. Therefore, waste-generation rates for the proposed LNP reactors are anticipated to be much closer to the expected rate, shown in Table 6-13, than the maximum rate.

Table 6-13. Summary of Radioactive Waste Shipments from the LNP Site and Alternative Sites for a Single AP1000 Reactor

Reactor Type	Waste-Generation Information	Annual Waste Volume, m^3/yr per Unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/1100 MW(e) Unit (880 MW[e] Net)[(a)]	Shipments/ 1100 MW(e) (880 MW[e] Net) Electrical Output[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46
Levy County Westinghouse AP1000, expected	1964 ft^3/yr per unit[(c)]	56	1115[(c)]	47	21

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 L (0.21 m^3).

(a) Capacity factors used to normalize the waste-generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972) and 93 percent for the proposed LNP Westinghouse AP1000 (PEF 2009a). Waste generation for the Westinghouse AP1000 is normalized to 880 MW(e) net electrical output (1100-MW[e] unit with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 (82.6 ft^3 per shipment [108 m^3/yr divided by 46 shipments/yr]).

(c) This value was taken from the PEF ER (PEF 2009a).

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste is well below the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S–4, for a Westinghouse AP1000 reactor located at the LNP site and alternative sites. Doubling the shipment estimates to account for empty return shipments of fuel and waste is included in the results. An additional doubling to account for a second reactor at the LNP site or alternative sites is also less than the one-shipment-per-day condition.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

The nonradiological impacts of radioactive waste shipments were calculated using the same general approach used for unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). These rates were adjusted to account for under-reporting, as described in Section 6.2.1.3. The results are presented in Table 6-14. As shown, the calculated nonradiological impacts for transportation of radioactive waste other than spent fuel from the LNP site and alternative sites to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the LNP Site and Alternative Sites with a Single AP1000 Reactor

	Shipments per Year	One-Way Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	46	800	3.4×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
LNP and Alternative Sites, Westinghouse AP1000	21	800	1.6×10^{-2}	7.8×10^{-3}	4.9×10^{-4}

Note: The shipments and impacts have been normalized to the reference LWR.

6.2.4 Conclusions for Transportation

The NRC staff performed an independent confirmatory analysis of the impacts under normal operating and accident conditions of transporting fuel and wastes to and from a Westinghouse AP1000 reactor to be located at the LNP site. Four alternative sites also were evaluated, including Crystal River, Dixie, Highlands, and Putnam (PEF 2009a). To make comparisons to Table S–4, the environmental impacts were adjusted (i.e., normalized) to the environmental impacts associated with the reference LWR in WASH-1238 (AEC 1972) by multiplying the AP1000 reactor impact estimates by the ratio of the total electric output for the reference reactor to the electric output of the proposed reactor.

Because of the conservative approaches and data used to calculate impacts, the NRC staff does not expect the actual environmental effects to exceed those calculated in this EIS. Thus, the NRC staff concludes that the environmental impacts of the transportation of fuel and radioactive wastes to and from the LNP site and alternative sites would be SMALL, and would be consistent with the environmental impacts associated with the transportation of fuel and radioactive wastes to and from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

The NRC staff notes that on March 3, 2010, DOE (2010) submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, Nevada. Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case Florida to Nevada. The distance from the LNP site or any of the alternative sites to any new planned repository in the contiguous United States would be no more than double the distance from the LNP site or alternative sites to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent reactor fuel, as presented in this section, would provide a reasonable bounding estimate of the impacts to meet the needs of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq). The NRC staff concludes that the environmental impacts of these doubled estimates would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, NRC regulations require that the facility undergo decommissioning. Decommissioning is the safe removal of a facility from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75.

An applicant for a COL is required to certify that sufficient funds will be available to ensure radiological decommissioning at the end of power operations. As part of its COL application for the proposed Units 1 and 2 on the LNP site, PEF included a Decommissioning Funding Assurance Report (PEF 2009c). PEF would establish an external sinking funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement I, Regarding the Decommissioning of Nuclear Power Reactors* (GEIS-DECOM), NUREG-0586 Supplement 1 (NRC 2002). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the advanced boiling water reactor are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the AP1000 reactor.

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 6.3×10^4 MT without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix I. A 40-yr SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

The NRC staff relies upon the bases established in the GEIS-DECOM and concludes the following:

1. Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in GEIS-DECOM is used.
2. Occupational doses would be well below applicable regulatory standards during the license term.
3. The quantities of Class C or greater than Class C wastes generated would be comparable or less than the amounts of solid waste generated by reactors licensed before 2002.
4. Air quality impacts of decommissioning are expected to be negligible at the end of the operating term.
5. Measures are readily available to avoid potential significant water-quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
6. Ecological impacts of decommissioning are expected to be negligible.
7. Socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

6.4 References

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7.0 Cumulative Impacts

The review team, composed of the U.S. Nuclear Regulatory Commission (NRC) staff and U.S. Army Corps of Engineers (USACE) staff, evaluated the potential impacts of construction and operation of two new nuclear units at the Levy Nuclear Plant (LNP) site proposed by Progress Energy Florida, Inc. (PEF) in its application for combined construction permits and operating licenses (COLs) (PEF 2009a). In doing so, the review team considered potential cumulative impacts on resources that could be affected by the combination of construction, preconstruction, and operation of two Westinghouse Electric Company LCC AP1000 pressurized water reactors at the LNP site, and other past, present and reasonably forseeable future actions.

The National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321, et seq.), requires Federal agencies to consider the cumulative impacts of proposed actions under their review. Cumulative impacts may result when the environmental effects associated with the proposed action are compounded with temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. For purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable through the building and operation of proposed LNP Units 1 and 2, including decommissioning. The review team considered cumulative effects of the proposed LNP Units 1 and 2 with past, present, and reasonably foreseeable future actions. The geographic area over which these actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time on the same resources.

In accordance with Title 10 of the Code of Federal Regulations (CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned by the review team to each impact category, as presented in Chapter 1. The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions in the general area surrounding the LNP site that would affect the same resources affected by the proposed new units, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined as “cumulative” in 40 CFR 1508.7 and include individually minor but collectively potentially significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a)) are described and characterized in Chapter 4 and those related to operations are described and characterized in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area.

This chapter includes an overall cumulative impact assessment for each resource area. The specific resources that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could affect the same resources as the proposed action.

The review team visited the LNP site in December 2008. The team then used the information provided in the ER, responses to Requests for Additional Information, information from other Federal and State agencies, and information gathered during the LNP site visit to evaluate the cumulative impacts of building and operating a nuclear facility at the proposed site. To inform the cumulative analysis, the review team researched the U.S. Environmental Protection Agency's (EPA) databases for recent EISs within Florida, used an EPA database for permits for water discharges in the area to identify water-use projects, and used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Other actions and projects that were identified during this review and considered in the review team's independent analysis of the cumulative effects are described in Table 7-1. Distances listed in Table 7-1 are from the planned powerblock location except as otherwise noted.

7.1 Land-Use Impacts

The description of the affected environment in Section 2.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.1, the NRC staff concludes that the impacts of NRC-authorized construction on land use would be SMALL and no further mitigation would be warranted. As described in Section 5.1, the review team concludes that the impacts of operations on land use would also be SMALL and no further mitigation would be warranted.

Table 7-1. Past, Present, and Reasonably Foreseeable Future Projects and Other Actions Considered in the Levy Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and decommissioning of Crystal River Energy Complex (CREC) Units 1-5	The CREC consists of five power-generating plants operated by PEF, four fossil-fuel plants and one nuclear plant. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The nuclear plant began operations in 1977.	About 9 mi southwest of the LNP site	Operational. The State of Florida Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fuel units by December 31, 2020, assuming licensing, construction, and commencement of operation of LNP occur in a timely manner (EIA 2010: FDEP 2010a).
Renewal of the CREC nuclear Unit 3	Extension of operations of CREC Unit 3 for an additional 20-year period beyond the end of the current license term, which is valid through midnight December 3, 2016.	About 9 mi southwest of the LNP site	Proposed. If granted, the license renewal would provide PEF the authority to continue operations through 2036. The draft supplemental EIS for the license renewal is scheduled to be issued in 2010 (PEF 2008a; NRC 2010).
Uprate at CREC Unit 3	CREC Unit 3 is planning to request a power uprate, or increase in the maximum power level at which the nuclear power plant may operate. The project would also include construction of a new helper cooling tower.	About 9 mi southwest of the LNP site	Proposed. The application submitted to the State of Florida was approved in August 2008. USACE issued a public notice on May 25, 2010. A Federal application is expected to be submitted to NRC in 2010. (PEF 2009b).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Inglis Lock bypass channel spillway hydropower project	2-MW hydroelectric project at the existing Inglis Lock bypass spillway. The project would include construction of an intake structure, intake and discharge channels, turbines, and a transmission line.	About 4 mi south-southwest of the LNP site	Proposed. An application has been submitted to the Federal Energy Regulatory Commission (Inglis 2009).
Florida Gas Transmission Company, LLC (FGT) Phase VIII Expansion Project	Construction and expansion of natural-gas pipelines, new compressor, meter, regulator stations, and other appurtenant facilities	Various Counties in Alabama and Florida, including Levy, Citrus, and Hernando. Collocated with US-19 in the vicinity of the LNP site	Completion expected by 2011 (FERC 2009; Panhandle Energy 2010).
Mining Projects			
Tarmac King Road Limestone Mine	A 9400-ac aggregate mining site. The mining site would be 4900 ac (including 900 ac set aside for wetlands); with remaining 4500 ac donated to Florida for preservation.	The eastern border of the site is about 2 mi west of the LNP site	Proposed. A permit application was submitted to USACE in September 2007. A draft EIS is expected to be completed in 2010 (USACE 2008; PEF 2009c).
Holcim Mine	Limestone quarry	About 7 mi southwest of the LNP site	Operational (FDEP 1997)
Inglis Quarry	Limestone quarry	About 6 mi southwest of the LNP site	Operational (EPA 2010a)
Crystal River Quarries – Red Level	Limestone quarry	About 7 mi south of the LNP site	Operational (EPA 2010b)
Crystal River Quarries – Lecanto	Limestone quarry	About 19 mi south-southeast of the LNP site	Operational (EPA 2010c)
Gulf Hammock Quarry	Limestone quarry	About 12 mi north of the LNP site	Operational (EPA 2010d)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Transportation Projects			
Cross Florida Barge Canal (CFBC)/ Marjorie Harris Carr Cross-Florida Greenway	The CFBC was a proposal to connect the Gulf of Mexico to the Atlantic Ocean. Two sections were partially constructed between 1964 and 1971. A constructed section extends westward from Lake Rousseau to the Gulf of Mexico. Portions of the CFBC are currently used as part of the Marjorie Harris Carr Cross Florida Greenway (FDEP 2010b).	About 3 mi south of the LNP site	Operational downstream of Lake Rousseau. Marjorie Harris Carr Cross Florida Greenway is currently managed as a protected greenbelt corridor. Construction was suspended January 1971 (FDEP 2010b).
Parks and Aquaculture Facilities			
Goethe State Forest	A 53,398-ac forest managed by Florida Department of Agriculture and Consumer Services (FDACS) for timber management, wildlife management, outdoor recreation, and ecological restoration (FDACS 2010).	Adjacent to the northeastern boundary of the LNP site	Development likely limited in this area (PEF 2009a)
Other parks, forests, and reserves	Numerous State and national parks, forests, reserves, and other recreational areas, including: Inglis Island Trail, Inglis Lock Recreation Area, Cedar Keys National Wildlife Refuge, Cummer Sanctuary, Crystal River National Wildlife Refuge, Lower Suwannee National Wildlife Refuge; Withlacoochee State Forest; Ocala National Forest; Crystal River Preserve State Park; Silver River State Park; and the Homosassa Springs Wildlife State Park.	Throughout the 50-mi region	Development likely limited in these areas (PEF 2009a)

1 **Table 7-1**. (contd)

Project Name	Summary of Project	Location	Status
Crystal River Mariculture Center	Multi-species marine hatchery	About 7 mi southwest of the LNP site adjacent to CREC.	Operational (FFWCC 2010)
Other Aquaculture Facilities	Multi-species marine hatcheries	Throughout region	Operational
Other Actions/Projects			
Commercial forest management	Managed forests for timber production	Throughout region	Operational
Commercial dairies	Several dairies are located within the 50-mi region including the Levy County Dairy, Alliance, and Piedmont Dairies, Hill Top Dairy, and Oak Grove Dairy, Inc.	Throughout region	Operational
Minor water dischargers and wastewater-treatment plants	National Pollutant Discharge Elimination System (NPDES)-permitted dischargers in Fanning Springs, Trenton, Blitchville, Bell, Chiefland, Cedar Key, Suwannee, and other locations.	Throughout region	Operational
Concrete companies	Two ready-mixed concrete suppliers	Northern Levy County	Operational (EPA 2010e, f)
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Within 50 mi	Operational in nearby cities and towns.

2

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Future urbanization	Construction of housing units and associated commercial buildings, such as the proposed Port District near Inglis; roads, bridges, and rail, such as the Suncoast toll road expansion; and the U.S. Highway 19 (US-19) bridge and highway expansions; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents. There is a low potential for increased urbanization within Levy and Citrus Counties because population growth is expected to be less than 2 percent per year (see Table 2-16)	About 6 mi southwest of the LNP site and throughout region.	Construction would occur in the future, as described in local land-use planning documents (FTE 2010; FDOT 2010a, b; Citrus County 2009)[a].

The review team is aware of recent events in the Gulf of Mexico associated with the Deepwater Horizon oil spill. To date, information associated with impacts to aquatic and terrestrial resources is preliminary and inconclusive. Although not included in this EIS, the review team will consider information associated with the oil spill for the LNP project as it becomes available.

The combined impacts from construction and preconstruction are described in Section 4.1 and they were determined to be MODERATE and would be mitigated as described in Section 4.1. In addition to land-use impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts. For this cumulative impacts analysis, the geographic area of interest is the area within the 15-mi radius of the LNP site and the transmission-line corridors. The review team determined that a 15-mi radius would represent the area that would be directly affected because it includes the primary communities (such as Inglis, Crystal River, Yankeetown, and Dunnellon) that would be affected by the proposed project.

Historically, Levy County was known for mining and timber operations. Much of the LNP site was used for intensive pine tree production and harvesting operations. The natural vegetation and land surface were significantly altered by these operations, which resulted in a series of hillocks and furrows. Lake Rousseau was formed when the Withlacoochee River was dammed in the early 1900s. The Cross Florida Barge Canal (CFBC) was partially constructed from the Gulf of Mexico to Lake Rousseau, and other lands acquired to construct the CFBC are now managed as the Marjorie Harris Carr Cross-Florida Greenway to conserve natural resources and provide recreational opportunities. The Crystal River Energy Complex (CREC, an energy facility also owned by PEF), constructed over a period from the 1960s to the 1980s, currently consists of a single 860-MW nuclear unit and four coal-fired generating units. From 1960 until 1985, the population of Levy County increased from about 10,000 to about 22,000, and the population of Citrus County increased from about 10,000 to about 70,000 (CensusScope 2010). Thus, residential land use in the region increased dramatically during that period. Currently, the region around the LNP site is largely rural and undeveloped land. Approximately 17 percent of the land is cropland and pasture, 15 percent is nonforested wetlands, 12 percent is residential, 12 percent is bays and estuaries, 9 percent is forested wetlands, 9 percent is deciduous forest land, 8 percent is other agricultural land, and 8 percent is mixed forest land (PEF 2009a).

Within the region, the reasonably foreseeable project with the greatest potential to affect cumulative land-use impacts would be the Tarmac King Road Limestone Mine. The 4900-ac mine site is located 1 mi west of the intersection of US-19 and King Road in Levy County, within about 2 mi of the LNP site. About 2700 ac would be mined over about a 100-year period, with an additional 1300 ac disturbed to site a quarry processing plant, roads, and other infrastructure. The company plans to donate another 4500 ac of land to the State of Florida for preservation. Tarmac America LCC (Tarmac) has applied for permits to begin construction of the mine in 2011, with operations beginning in 2013. Tarmac estimates that at the height of mining activity, about 500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). The potential impacts from this increased traffic, coupled with traffic from the LNP site, are considered in Section 7.4. Completion of the new US-19 bridge and highway expansion in the fall of 2010 would alleviate some of the traffic issues. Because the mine would include less than 2 percent of the geographic area of interest, not including the Gulf water area, the review team expects that the proposed Tarmac mine would have a minimal impact on land use. However, because the LNP site is only 2 mi from the proposed mine, together the projects would have a noticeable, but not destabilizing, impact on land use.

In the State of Florida's Conditions of Certification for the LNP site (FDEP 2010a), CREC Units 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, construction activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. Land use at the CREC site likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally, although ash would still be available from coal-fired Units 4 and 5. PEF has also proposed to install a new helper cooling tower on the south bank of the

CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). The review team expects that land-use impacts associated with these projects would be minimal.

As described in Table 2-1, approximately 180 mi of entirely new transmission-line corridors would be built to support proposed LNP Units 1 and 2, although new corridors would be located adjacent to existing utility corridors to the extent practicable. New transmission lines would convert 547 ac of “Hardwood – Conifer Mix”, 247 ac of “Coniferous Plantation,” and 192 ac of “Cypress” land uses, among others, to utility land use, and would pass through undisturbed areas. Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects the corridors would have a noticeable impact on the local area.

Future urbanization in the review area could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increase in residential and industrialized areas. Currently, only about 12 percent of the region around the LNP site is in residential land use. Local land-use planning documents describe future construction of residential and commercial buildings, although such development would likely be limited because the predicted growth rate in the area is approximately 2 percent (see Table 2-16). The Florida Department of Transportation currently plans to expand the US-19 bridge and the Suncoast toll road. Florida Gas Transmission Company (FGT) proposes to expand its liquefied natural gas pipeline collocated with US-19, near the LNP site. These projects would have limited impacts on land use because a small incremental amount of land would be converted to a new land use, and it would be adjacent to the current roads or pipelines. Development would likely be limited in the nearby Goethe State Forest and other parks and recreational areas. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), and may change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing State and national forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Because other projects listed in Table 7-1 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable.

Based on its evaluation, the review team concludes that the cumulative land-use impacts associated with construction, preconstruction, and operations of the proposed LNP and other past, present, and reasonably foreseeable projects in the geographic area of interest would be MODERATE. The land-use impacts would be sufficient to alter noticeably, but not destabilize, important attributes of the land resource. The incremental land-use impacts associated with the transmission-line corridors for the project and the Tarmac King Road Limestone Mine in combination with the LNP site are the principal contributors to the MODERATE characterization of cumulative land-use impacts. Transmission-line corridors would pass through undisturbed lands, including wetlands, and PEF and the State of Florida have identified mitigation measures to be taken. Because the NRC does not authorize the building of transmission lines, the NRC staff concludes that the incremental impacts of NRC-authorized activities would be SMALL.

7.2 Water Use and Quality

This section analyzes the cumulative impacts of the proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects on water use and water quality.

7.2.1 Water-Use Impacts

This section describes cumulative water-use impacts from construction, preconstruction, and operations of proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects.

7.2.1.1 Surface-Water-Use Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on surface-water use would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on surface-water use would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined surface-water-use impacts from construction and preconstruction are described in Section 4.2.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect surface-water use, including the potential impacts of global climate change, as discussed above. For this analysis, the geographic area of interest is strongly influenced by the site’s proximity to the Gulf of Mexico, which could theoretically provide a virtually unlimited water source. To examine cumulative surface-water-use impacts, this analysis includes the area within 20 mi of the LNP site, which would be expected to encompass the area affected by the proposed units and other area water users in this region of the Florida Gulf Coast. The 20-mi region is partially located within Levy, Citrus, and Marion counties. Within this region, past, present, and foreseeable future actions that contribute to cumulative impacts include the existing CREC units, a planned uprate of CREC Unit 3, potential decommissioning of CREC Units 1 and 2, existing and proposed mines, and proposed transportation projects (see Table 7-1).

The LNP site is located in Levy County. A portion of Levy County is under the jurisdiction of the Southwest Florida Water Management District (SWFWMD) while the rest is under the Suwannee River Water Management District (SRWMD). The SRWMD water-supply plan, which was expected to be available in spring 2010, remains under development. According to the 2010 draft Regional Water Supply Plan prepared by the SWFWMD (2010), the Withlacoochee River is the only major river in the Northern Planning Region of the district where the LNP site is located. Although minimum flow for the Withlacoochee River has not yet been established, the SWFWMD (2010) stated that in the future, established minimum flows will provide some bound on the water supply from the river during low-flow conditions. In a preliminary study conducted by the Withlacoochee Regional Water Supply Authority in cooperation with the SWFWMD, the agencies concluded that an additional 93 Mgd of surface water supply may potentially be available from the river. Currently, minor withdrawals totaling 0.5 Mgd are permitted from the Withlacochee and the Rainbow rivers (SWFWMD 2010). The proposed LNP units would not withdraw surface waters from the Withlacoochee River, the Suwannee River, or their tributaries. Because the Gulf of Mexico is a virtually unlimited source, historical water use impact on it from recreation and industry (e.g., CREC power plant units) is undetectable. Mining activities in Levy, Citrus, and Marion counties used 1.8 Mgd in 2005 and are expected to use 4 Mgd by 2030 (SWFWMD 2010). These mining uses include surface and groundwater.

The LNP units would withdraw water from the CFBC, which is connected to the Gulf of Mexico. The CFBC receives freshwater inflows from the Old Withlacoochee River (OWR, a remnant arm of the Withlacoochee River) and groundwater springs in addition to tidal exchanges of saltwater from the Gulf of Mexico. The review team determined that the consumptive use of surface water for operation of the proposed units (no surface water use is planned for construction and preconstruction activities) would remain undetectable relative to the volume of water in the Gulf of Mexico and minor within the 20-mi area surrounding the LNP site. The predominant surface-water user within this area is CREC, and its withdrawals have an insignificant effect on surface water availability from the Gulf of Mexico. PEF has proposed to install a new helper cooling tower on the south bank of the CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). During critical summer months, similar to the existing group of helper cooling towers, the new helper cooling tower would withdraw discharged cooling water from CREC units and the discharged blowdown water from the LNP units and cool it before discharging the water back into the CREC discharge canal. The helper cooling tower would cool the waters in the CREC discharge canal sufficiently to meet the National Pollutant Discharge Elimination System (NPDES) maximum temperature limit. Because the helper cooling tower would only be required to cool the discharged water a few degrees, and because it would operate only a few months during the year, the consumptive use of the new helper tower is expected to be minimal.

Another proposed project in the area, is the development of the Inglis Lock bypass channel spillway hydropower project. There would be minor water use during building and installation of the hydropower project. The review team determined that water use during building and installation would be temporary and would therefore not result in a cumulative impact on water availability in the area. The project would not result in consumptive use of surface water during its operation and therefore would not have a cumulative impact on water availability in the geographic area of interest. The impacts of other projects listed in Table 7-1 are considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on surface- water use.

For this water-use analysis, the review team considered forecasted changes to temperature and precipitation for southwest Florida. For the State of Florida, the projected range of change in temperature from “present day” (1993–2008) to the period encompassing the licensing action (i.e., 2040 to 2059) is reported in the U.S. Global Change Research Program (GCRP) report to be between 1 to 4°F (GCRP 2009). While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation from the “recent past” (1961–1979) to the period 2080 to 2099 is a decrease of between 20 to 25 percent in spring and an increase of between 15 to 20 percent in the fall (GCRP 2009). Declines in aquifer water levels may continue throughout Florida, as the aquifers are relied on in response to changes in precipitation and the growth in demand for freshwater (GCRP 2009). Such changes in climate could result in adaptations to both surface-water and groundwater management practices and policies that are unknown at this time.

Global climate change could result in changes in seasonal precipitation and increased temperatures. These forecasted changes have the potential to reduce surface runoff and increase evapotranspiration. Changes in climate during the life of proposed Units 1 and 2, described above, could result in either an increase or decrease in the amount of runoff; however, the divergence in model projections for the southeastern United States precludes a definitive estimate (GCRP 2009). While the changes that are attributed to climate change in these studies are not insignificant, the review team did not identify climate change related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter its assessment that the impacts to the surface water resource would be minor. Also based on this compilation, it is reasonably foreseeable that sea level rise may exceed 3 ft by the end of the century due to global climate change (GCRP 2009). The increase in sea level relative to the CFBC and the Withlacoochee River, potentially coupled with reduced streamflow (also due to global climate change), could result in the salt water front in the CFBC and the Withlacoochee River moving upstream.

The review team determined that the consumptive use of water from the operation of LNP Units 1 and 2 and all other consumptive uses (existing or likely future uses) would not alter the volume of water in the Gulf of Mexico and would not noticeably alter the surface water resource within 20 miles of the LNP site. Based on its evaluation, the review team concludes that the cumulative impacts on surface water from construction, preconstruction, and operations of two new nuclear units and other past, present, and reasonably foreseeable future activities would be SMALL, and no mitigation would be warranted. As stated above, the review team also considered global climate change-related effects on the surface water resource. While these changes from global climate change may not be insignificant, the review team has not identified climate change-related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter the conclusions presented above.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater use would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined impacts from construction and preconstruction are described in Section 4.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect groundwater use, including potential effects of global climate change. For this analysis, a geographic area of interest has been identified which extends 20 mi from the LNP site. This 20-mi region is sufficiently large to characterize potential cumulative groundwater use impacts. As discussed in Section 2.3.1.2, groundwater in the Upper Floridan aquifer at the Levy site moves west-southwest from areas of higher hydraulic head east of the site to discharge to local springs and offshore springs in the Gulf of Mexico. The surficial and the Upper Floridan aquifers could be affected by water withdrawal for construction, preconstruction, and operation of proposed LNP Units 1 and 2.

The geographic area of interest described above is located within two Florida water management districts – the SWFWMD and the SRWMD. Within the SWFWMD, the geographical area of interest falls in the Northern Planning Region of the district. The SWFWMD has monitored the groundwater resources in the Northern Planning Region since the passage of the 1972 Florida Water Resources Act including the initiation of the water resources assessment project in the late 1980s which continues today (SWFWMD 2010). The assessment led to modifications to the district's permitting rules. The Northern planning region has recently experienced population growth and development leading to larger groundwater withdrawals. The average (non-drought) water demand in the Northern Planning Region in 2005 was 82 Mgd and is projected to increase to 106 Mgd in 2010 and 154 Mgd in 2030 (SWFWMD 2010). The SWFWMD has estimated that during 2010-2030, potential water availability in the Northern Planning Region could be 240 Mgd (SWFWMD 2010). However, this estimated water availability includes contributions from unused permitted and available unpermitted surface waters from the Withlacoochee River, reclaimed water, desalination of seawater, and conservation measures (SWFWMD 2010). The projected 2030 water demand cannot be met solely by groundwater from the Upper Floridan aquifer. The review team concludes that groundwater has historically been extensively used in the region and therefore has noticeably altered the resources. The alteration on groundwater resources from historical use is also evident from the careful planning and permitting process the SWFWMD uses to ensure that impacts to the resource is minimized.

Near-term alterations of the groundwater supply due to projected use of 1.58 Mgd of groundwater for LNP operations are expected to be minor, based on the results of predictive simulations, and on conditions imposed for certification by the State of Florida that limit the allowable drawdown caused by pumping from the LNP wellfield (see Section 5.2.2.2). Projected future groundwater usage by all permitted users within the boundary of the local-scale groundwater flow model, based on population projections from the 2000 U.S. census, is discussed in Section 2.3.2.2. The increase in usage is projected to be relatively small (from 3.51 Mgd in 2001 to 10.3 Mgd in 2078; see Section 2.3.2.2) compared to the estimated water balance for the local-scale groundwater flow model domain (208 Mgd; see Section 5.2.2.2). Therefore, the review team determined that cumulative impacts of both the proposed LNP project and other current and future permitted groundwater users are also expected to be minor. The SWFWMD has determined that the groundwater use at the proposed LNP site would be limited and would not significantly affect future planning in the region (FDEP 2010a).

Agriculture and other activities (e.g., existing mining activities at the Inglis Rock Quarry) have historically used groundwater in the region of interest. FDEP and SWFWMD have developed a proactive groundwater management program to preserve and manage groundwater resources. Other potential cumulative impacts include changes in the groundwater system associated with climate change (see discussion in Section 7.2.1.1 above) and the proposed Tarmac King Road Limestone Mine.

The Tarmac King Road Limestone Mine is proposed to be located about 2 mi west of the LNP site. Tarmac has applied for permits to begin site development in 2011, with operations beginning in 2013. The Tarmac Mine site would be 9400 ac in area of which 2700 ac, consisting of wetlands and uplands, would be mined. A 900-ac area would be set aside for wetlands and 4500 ac would be donated to the State of Florida for preservation. This limestone mine is expected to use less than 1 Mgd of water (PEF 2009a), which is comparable to LNP operational usage. Currently, the USACE is preparing a DEIS for the Tarmac Mine that would evaluate the impacts of water use associated with the Tarmac Mine project. Although no specific evaluation of the impacts of water use at the Tarmac mine on groundwater levels and wetlands was performed for the LNP Units 1 and 2 DEIS, the review team determined that the effects of water use at the Tarmac Mine site on the groundwater resource would be of the same order of magnitude as those predicted for the LNP wellfield located on the LNP site because both projects would withdrawal a comparable amount of groundwater. As discussed in Section 5.2.2.2, a modeling evaluation indicated that average LNP operational groundwater use (1.58 Mgd) represents only a small percentage (0.8 percent) of the total water flux (208 Mgd) moving through the groundwater model domain. Assuming similar geohydrologic conditions at the Tarmac site, the review team determined that the proposed water use would also be a relatively small amount of the flux moving through the groundwater system.

The projected groundwater usage associated with normal LNP operation and temporary increases in withdrawal rate associated with maximum daily operation are small relative to the groundwater resource. Since no other past, present, or reasonably foreseeable actions with significant impacts were identified, the review team concludes that cumulative impacts on the groundwater resource from preconstruction, construction, and operation of the proposed LNP units, and other past, present, and reasonably foreseeable projects, including the potential of decreased precipitation and increased temperatures due to global climate change, would be SMALL, and mitigation beyond the conditions imposed for certification by the State of Florida discussed in Chapters 4 and 5 would not be warranted. Global climate change could result in alteration of the groundwater resource in the geographic area of interest by varying the recharge to the aquifers, changing the use of agricultural chemicals, and affecting land use patterns. While the changes in groundwater resource that are indirectly attributable to climate change may not be insignificant, the review team did not identify climate change related effects at the local and regional scale under the currently unknown adaptations to water-management policies that would alter its conclusion regarding groundwater use.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts from construction, preconstruction, and operations of proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects.

7.2.2.1 Surface-Water-Quality Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for the cumulative impacts assessments in this resource area. As described in

Section 4.2, the impacts from NRC-authorized construction on surface-water quality would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on surface-water quality would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined surface-water-quality impacts from construction and preconstruction are described in Section 4.2.3.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect surface-water quality. For the cumulative analysis of impacts on surface water, the review team analyzed impacts to the CFBC between Lake Rousseau and the Gulf of Mexico and the area within 20 mi of the LNP site because this is the area that would exhibit effects from cumulative impacts. The 20-mi region is partially located within Levy, Citrus, and Marion counties. Within this region, past, present, and foreseeable future actions that contribute to cumulative impact include the existing CREC units, a planned uprate of CREC Unit 3, potential decommissioning of CREC Units 1 and 2, existing and proposed mines, and proposed transportation projects (see Table 7-1). The discharges from the CREC and existing projects are permitted by existing NPDES permits. The potential discharges from other proposed projects would also be permitted under NPDES permits and best management practices would be used to minimize runoff that may adversely affect water quality of receiving waters in the region.

As stated in Section 2.3.3.1 of the EIS, there are some waterbodies near the LNP site that are listed on the State's 303(d) list of impaired waterbodies (FDEP 2010c). Historical point and non-point source discharges have affected the water quality of streams and rivers near the LNP site. Lake Rousseau and the lower Withlacoochee River appear on the draft 2010 303(d) List as impaired waterbodies because of the presence of mercury in fish tissue (FDEP 2010c). The State of Florida has a Total Maximum Daily Loads (TMDL) program to help protect and restore the quality of waters. In addition, the State of Florida also designates waterbodies as Outstanding Florida Waters (OFWs) and special waters to which pollutant discharges are generally prohibited. The lower Withlacoochee River near the LNP site is an OFW. Lake Rousseau and the CFBC are not designated as OFWs. LNP Units 1 and 2 would not discharge to the lower Withlacoochee River or the CFBC. The other existing and reasonably foreseeable projects mentioned above would either not discharge to these waterbodies or their discharges would be controlled by FDEP under State and Federal regulations. As stated above, the State of Florida, under the TMDL program, helps protect and restore the quality of impaired waters. Therefore, the review team determined that the cumulative impacts from existing, proposed, and reasonably foreseeable future action on these waterbodies would be noticeable but not destabilizing.

As described in EIS Section 5.2.3.1, the review team independently used the Finite Volume Coastal Ocean Model (MEDM 2010, Chen et al. 2003, 2004) to estimate the water-quality parameters of the discharge plume in the Gulf of Mexico. Table 5-1 lists the four configurations that resulted in eight simulated scenarios, one each for summer and winter conditions for each configuration. The cumulative impact on the Gulf of Mexico in the vicinity of the CREC discharge canal is a result of all past, present, and reasonably foreseeable future projects. These projects include the cooling-water discharge from CREC Units 1 through 5, uprate to Unit 3, and the blowdown discharge from the closed-loop cooling system of LNP Units 1 and 2. The review team also evaluated the impacts of the uprate to CREC Unit 3 and the potential future shutdown of CREC Units 1 and 2 on the water quality parameters, temperature and salinity, of the Gulf near the discharge point.

Based on the water-quality simulations described above, the review team determined that both during summer and winter, the combined discharge of CREC Units 1 through 5 including the uprate of Unit 3 and the blowdown discharge from LNP Units 1 and 2, would result in a thermal plume with a noticeably large area with increase in ambient Gulf water temperature of up to 5ºC. Therefore, the review team concluded that the cumulative impacts of the combined discharges from past, present, and reasonably foreseeable future projects on water temperatures in the Gulf would be noticeable. Based on the simulations described above, the review team also determined that both during summer and winter, the combined discharge would result in salinity increase of about 1 psu over ambient salinity of Gulf waters. Therefore, the review team concluded that the cumulative impacts of the combined discharges from past, present, and reasonably foreseeable future projects on the salinity in the Gulf would be noticeable. The incremental impact from LNP Units 1 and 2 on water quality would be minor. Other chemical releases are permitted by the NPDES process that also requires the respective projects to monitor these releases to ensure compliance.

PEF has proposed to install a new helper cooling tower on the south bank of the CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). During critical summer months, similar to the existing group of helper cooling towers, the new helper cooling tower would withdraw discharged cooling water from CREC units and the discharged blowdown water from the LNP units and cool it before discharging the water back into the CREC discharge canal. The helper cooling tower would cool the waters in the CREC discharge canal sufficiently to meet the NPDES maximum temperature limit. Because the helper cooling tower would only be required to cool the discharged water a few degrees and because it would operate only a few months during the year, the new helper tower is expected to only minimally change the water quality in the Gulf of Mexico.

The review team also simulated water quality parameters if CREC Units 1 and 2 were to shut down and only CREC Units 3 through 5 (including the uprated Unit 3) and LNP Units 1 and 2 were to remain in operation, as described as a condition by the State of Florida's Conditions of Certification (FDEP 2010a). Based on simulations described above, the review team determined that the plume in the Gulf would be significantly smaller because the cooling water discharge of the once-through cooling systems of CREC Units 1 and 2 would cease. However, increased water temperature in the smaller plume would still be noticeable compared to ambient water temperature. The salinity in the smaller plume, however, would increase slightly because the operating units have closed-cycle cooling systems that use 1.5 cycles of concentration. The maximum increase in salinity would be about 1.5 psu over ambient salinity in the Gulf. Therefore, the review team concluded that the cumulative impacts of the combined discharges, if CREC Units 1 and 2 were to shut down, on water temperature and salinity in the Gulf would be noticeable. As stated above, the review team concluded that the contribution of LNP Units 1 and 2 to the noticeable cumulative impact would be minimal.

As stated in Section 2.3.1.1, it is reasonably foreseeable that sea-level rise may exceed 3 ft by the end of the century due to global climate change (GCRP 2009). The increase in sea level could result in the saltwater front moving farther inland in the CFBC. As stated above, global climate change could result in changed precipitation and increased temperatures in the vicinity of the proposed plant. These forecasted changes have the potential to reduce surface runoff, increase evapotranspiration, change cropping patterns, and alter nutrient loadings to runoff. The changes may result in alteration of the surface-water quality in the region.

As stated above, global climate change could result in decreased precipitation and increased temperatures in the geographic area of interest (GCRP 2009). These forecasted changes have the potential to reduce surface runoff, increase evapotranspiration, change cropping patterns, and alter nutrient loadings to runoff. The changes may result in alteration to the surface-water quality in the region.

Other present and reasonably foreseeable future actions in the geographic area of interest that could contribute to cumulative impacts on surface-water quality include the operation of CREC, Units 1-5, the renewal of the license for Unit 3, a proposed power uprate for Unit 3, and the possible closure of two CREC coal-fired units. The areal extent of the influence of these facilities on water quality would be noticeable in the Gulf's nearshore marine environment, but not destabilizing to the resource. Based on its evaluation, the review team concludes that the cumulative surface-water-quality impacts would be MODERATE. The contribution of LNP Units 1 and 2 to these impacts is minor. Therefore, the incremental impacts from NRC-authorized activities, would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted. While the effects on water quality from global climate change related to changes in sea level, precipitation, and temperature described above in the region may not be insignificant, the review team has not identified climate-change related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter the conclusions presented above.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater quality would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-quality impacts from construction and preconstruction of the proposed LNP units are described in Section 4.2.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable projects that could affect groundwater quality, including the potential impacts of global climate change. For this analysis, a geographic area of interest has been identified which extends 20 mi from the LNP site. Because the extent of the zone of influence of the possible groundwater wells is less than 2 miles, this 20-mi region is sufficiently large to characterize potential cumulative groundwater-quality impacts.

The FDEP Conditions of Certification would require a cleanup of any spills that may occur at the LNP site. Therefore, any impacts on the quality of the aquifer that exists beneath the site from activities associated with construction, preconstruction and operation of the proposed units would not affect this resource regionally.

Land-use changes, agriculture, and other activities (e.g., existing mining activities at the Inglis Rock Quarry) have historically used groundwater in the region of interest. FDEP and SWFWMD have developed a proactive groundwater-management program to preserve and manage groundwater resources including groundwater quality (Fla. Admin. Code 62-520). Based on the importance of the underlying aquifer, projects are required by the FDEP to control and prevent effluent discharges to the groundwater (Fla. Admin. Code 62-520). Best management practices would be used at current and proposed mining projects to ensure that the adverse effects to groundwater quality are minimized.

Global climate change can result in a rise in sea level (GCRP 2009) that may induce saltwater intrusion in the surficial and Floridan aquifers. Projected changes in the climate for the region during the life of the proposed LNP units include an increase in average temperature and a decrease in precipitation. These changes are likely to result in changes to agriculture including crops, pests, and the associated changes in application of nutrients, pesticides, and herbicides that may reach groundwater. As a result, groundwater quality may be altered by the infiltration of chemicals. Under the geohydrologic and operational conditions present at the LNP site, operational groundwater-quality impacts would be minor.

Based on the fact that no other past, present, or reasonably foreseeable actions with significant impacts on groundwater quality were identified, the review team concludes that cumulative impacts on the quality of the groundwater resource would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted. While the changes in groundwater quality that are indirectly attributable to climate change may not be insignificant, the review team did not identify climate change related effects at the local and regional scale under the currently unknown adaptations to water-management policies that would alter its conclusion regarding groundwater quality above.

7.3 Ecology

This section addresses the cumulative impacts on terrestrial and aquatic ecological resources as a result of activities associated with the proposed LNP project and other past, present, and reasonably foreseeable future activities within the geographic area of interest for each resource.

7.3.1 Terrestrial Ecosystem Impacts

The description of the affected environment in Section 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial ecological resources, including wetlands and important species. As described in Section 4.3.1, the NRC staff concludes that impacts from NRC-authorized construction on terrestrial resources would be SMALL, and additional mitigation beyond that already proposed would not be warranted. As described in Section 5.3.1, the impacts of operations on terrestrial resources would be SMALL to MODERATE, and additional mitigation beyond that already proposed is not expected to be warranted. The conclusion in Section 5.3.1 is primarily based upon the uncertainty that exists regarding the potential effects of groundwater withdrawal on wetlands and associated biota.

The combined impacts from construction and preconstruction were described in Section 4.3.1 and determined to be MODERATE. The conclusion in Section 4.3.1 is primarily based upon the extent of impacts on wetlands, wildlife, and Federally and State-listed species. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and future actions that could affect terrestrial resources. For the cumulative analysis of terrestrial ecology, the geographic area of interest is considered to encompass the 20-mi radius around the LNP site, plus the corridors associated with the proposed transmission lines and other offsite linear features (as defined in Chapter 2). Corridors range in width from approximately 300 ft to 1 mi wide. The geographic area of interest is expected to encompass the locations of possible development projects potentially capable of substantially influencing terrestrial ecological resources on and close to the LNP project. This area generally coincides with those defined for hydrology and aquatic ecology, both of which are closely interrelated with the terrestrial ecology of this coastal setting. This area includes watersheds providing direct runoff from the LNP site to the Gulf of Mexico, as well as the lower watersheds of the Withlacoochee and Waccasassa river basins.

7.3.1.1 Wildlife and Habitats

The geographic area of interest is located primarily in the Gulf Coastal Flatwoods ecoregion, although portions of the corridors associated with the proposed transmission lines cross into the Southwest Florida Flatwoods and the Central Florida Ridges and Uplands ecoregions (EPA 2010c). Prior to European settlement, much of the geographic area of interest consisted of mature pine flatwoods interspersed with bottomland hardwood forests, cypress swamps, freshwater marshes and drier uplands. Today, most of the landscape has been altered by past actions such as forestry, farming, livestock grazing, and sparsely distributed urbanization. It remains largely rural in character, consisting of scattered small towns and large tracts of privately-owned forest and agricultural land, as well as local, State, and Federally-owned forestland parks and wetlands.

Past terrestrial and wetland habitat losses in the geographic area of interest have occurred primarily from urbanization (e.g., residences, commercial development, roads, and utility development), agricultural practices (including commercial forest management), mining, construction of the CFBC, and development of the CREC. Extensive areas of habitat have already been altered for forest management, agriculture, mining, and low density residential development. Development and operation of power plants at the CREC, which began in the 1960s, have contributed cumulatively to many of the same types of impacts on terrestrial ecological resources as those associated with the proposed LNP project. The cumulative impacts resulting from CREC operation would continue for the geographic area of interest. Habitat degradation in the geographic area of interest has already resulted from the conversion of natural landscapes to intensively managed forests, pastureland and other agricultural uses, rural residential development, and other developments causing fragmentation of the landscape. This cumulative loss, degradation, and fragmentation of habitat have already contributed to declines in wildlife populations and biodiversity within the area. In addition, decreased precipitation, sea-level rise, more frequent storm surges, increased intensity of coastal storms, and increased temperatures resulting from global climate change may already be contributing to wetland losses and exacerbating the ongoing trend (GCRP 2009).

The geographical area of interest, includes portions of State forests, parks, reserves, wildlife-management areas and other conservation areas. Most of the Goethe State Forest is managed for timber, wildlife, outdoor recreation and ecological restoration. Lake Rousseau contains shoreline habitats of high value to shorebirds, waterfowl, and other waterbirds. Lands acquired to construct the CFBC are now managed as the Marjorie Harris Carr Cross Florida Greenway to conserve natural resources and provide recreation. Other sensitive terrestrial ecological resources include the Waccasassa Bay Preserve State Park, Crystal River Preserve State Park, wetlands associated with the lower Withlacoochee and Waccasassa rivers, various springs (e.g., Big King Spring, Little King Spring) and other sensitive streams and habitats (see Figure 2-16). Wetlands are abundant in low-lying areas, and the proposed transmission line and other offsite corridors traverse streams, lakes, and riparian zones. This interspersion of wetlands, lakes, and protected uplands support a wide variety of wildlife and plants.

The impacts on terrestrial ecological resources from site preparation, development and operation of the proposed LNP Units 1 and 2 and associated transmission lines are described in Sections 4.3.1 and 5.3.1. As noted in Section 4.3.1.1, including Table 4-4, preconstruction and construction impacts on the LNP site would result in the permanent and temporary loss of about 777 ac of habitat, including approximately 403 ac of wetlands. As noted in Section 4.3.1.2, including Table 4-7, roughly 2037 ac of additional habitat would be disturbed to build the associated transmission lines and other offsite facilities, including about 370 additional ac of wetlands. PEF has committed to mitigating for the loss or impairment of functions in all wetlands affected by the LNP project (see Section 4.3.1.7).

Development of other projects, such as the proposed Tarmac King Road Limestone Mine, the proposed new helper cooling tower at CREC Unit 3, the Inglis Lock Bypass Channel Spillway Hydropower Project, the proposed expansion of the FGT pipeline, the proposed US 18 bridge upgrade, the proposed Sun Coast Toll Road extension, as well as anticipated continued urbanization and increased outdoor recreation would cumulatively contribute to losses of wetlands and other terrestrial habitats. For example, at the proposed Tarmac King Road Limestone Mine, about 2700 ac of wetlands and uplands would be mined, with an additional 1300 ac disturbed to site a quarry processing plant, roads and other infrastructure. Total wetland impacts are estimated at 1140 ac (BRA 2010). Tarmac plans to mitigate for wetland impacts by conducting a variety of conservation measures on a 4500-ac site adjacent to the proposed mine that would be protected through a conservation easement. The construction of the new helper cooling tower at CREC Unit 3 would result in the discharge of fill within approximately 1.3 ac of wetlands. Wildlife that occupies areas near where site clearing and wetland filling activities occur could be adversely affected as a consequence of habitat loss, and competition for remaining resources. Some wildlife would perish or be displaced during land clearing. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds and larger mammals, many of which would be displaced to adjacent communities. Undisturbed lands adjacent to areas of activity, such as parks and managed areas described in Table 7-1, could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels.

Global climate change may also result in loss of habitat. Sea-level rise resulting from climate change along the Gulf Coast of Florida could accelerate the loss of wetlands and estuaries, thus eliminating breeding and foraging habitat for wildlife (Ning et al. 2003; GCRP 2009). Global climate change could also cause shifts in species ranges and migratory corridors as well as changes in ecological processes (GCRP 2009).

Long linear projects that cross forested habitats; such as the proposed transmission line corridors, expansion of the FGT pipeline, and extension of the Sun Coast Toll Road, would also cumulatively contribute to habitat fragmentation. Habitat fragmentation is of particular concern for forested habitats, whose fragmentation decreases the amount of interior forested habitat required for certain species such as many warblers, vireos, and woodpeckers. The clearing of new utility rights-of-way could be beneficial for some species, including those that inhabit early successional habitat or use forest edge environments, such as white-tailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*), may exploit new hunting grounds provided by the new forest openings. Forested wetlands within the rights-of-way would be converted to, and maintained in, an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds.

Salt deposition from cooling-tower drift would occur at the LNP and would continue under normal operation of the CREC. Damage to vegetation and habitats from salt drift under current operation was documented to be minimal (see Section 5.3.1), and the requirement for salt drift monitoring was terminated by the FDEP in 1996 (PEF 2009d). Thermal mitigation for the proposed power uprate at CREC Unit 3 would involve building a new supplemental mechanical draft cooling tower at the CREC. This would increase the potential for cumulative salt-drift impact at the CREC. Based upon prior monitoring conducted at the CREC site, damage to vegetation and habitats from the anticipated increase in salt drift would be expected to be minor.

The impacts of cooling-tower drift for existing power plants were evaluated by the NRC (1996, 1999) [(a)] in NUREG-1437 and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. Because the LNP project cooling towers would be about 9 mi northeast of the CREC cooling towers, no overlap is expected between their respective cooling-tower plumes. Of 18 operating nuclear power plants where the effects of cooling-tower drift on vegetation were investigated by NRC to support anticipated operating license renewals, vegetation damage attributable to the drift was observed in a maximum area of about 20 ac (NRC 1996). Areas of vegetation damage attributable to overlapping plumes of salt drift from power plants 9 mi away are therefore unlikely. The license renewal GEIS (NRC 1996) indicates that the effects of increased humidity, ground-level fogging, and icing are similarly localized and that areas of overlapping effect from sources 9 mi distant would be unlikely. No other cooling towers associated with current or proposed energy projects lie within the geographic area of interest (Table 7-1). Consequently, potential cumulative

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[(a)] NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

impacts from cooling-tower plumes (salt deposition, fogging, and icing) would be minimal, limited to the CREC and LNP sites, and not expected to noticeably affect terrestrial resources.

The geographic area of interest lies within a branch of the Eastern Atlantic Flyway that crosses northern and central Florida, a migration route used by neotropical migrants and other birds (FWS 2010; Birdnature.com 2009). Cooling towers, other tall structures, and nighttime lights associated with the continued and proposed operations at the CREC and the proposed LNP project may present increased risks for collision and mortality for migrating birds. The CREC currently maintains two natural draft cooling towers, a four-bank low-profile mechanical draft cooling tower, and four tall stacks that support four coal-fired units. An additional low-profile mechanical draft “helper” cooling tower is planned at the CREC under the proposed CREC Unit 3 power uprate. The low height of the mechanical draft cooling tower at the CREC and the towers planned for the LNP site (about 56 ft above grade); however, are similar to other buildings at or proposed for the sites, and would not be expected to present a significant collision hazard for birds. Existing and future communication towers and other tall structures within the geographic area of interest could also present potential collision hazards to migrating birds. Although bird mortality resulting from disorientation and collisions with nighttime lighted structures has been documented, it would not be expected to represent a significant source of mortality and would have a minimal effect on populations.

Wildlife would be subjected to impacts from increased noise and traffic from the new LNP plant, Tarmac mine, expansion of the Sun Coast Toll Road, expansion of US 19, expansion of the FGT pipeline, as well as ongoing regional development. As discussed in Chapter 5, noise modeling predicts no perceptible to very slight increases in noise from LNP operations at the site boundary. Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 80- to 85-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Therefore, disturbance to wildlife from noise would be localized and should have minimal impact on overall population health. Noise from the operation of the Tarmac King Road Limestone Mine would include blasting once every week or two to loosen rock, noise associated with excavation and processing, and truck traffic in and out of the mine (Tarmac America 2010). Noise and vibrations from blasting and other operations would be required to be at or below limits imposed by the State of Florida. Noise levels would increase at the CREC with the addition of a new cooling tower to support the proposed CREC Unit 3 power uprate. Nevertheless, operational noise at the CREC site at levels that could substantially affect wildlife would not be expected beyond the site boundary (PEF 2007). Additional traffic on highways and roads would contribute to an incremental increase in traffic-related wildlife mortalities. It is estimated that about 500 trucks a day would leave the proposed site at the height of mining activity (Tarmac America 2010). These impacts from increased traffic would not be expected to noticeably reduce regional wildlife populations.

Operation of new transmission lines and corridors present increased risks for avian collision and electrocution beyond the risk posed by existing transmission lines. Siting new lines in or alongside existing corridors can reduce the potential for avian mortality by limiting the number of rights-of-way birds need to cross, and hence opportunities for collision. The proposed collocation of more than 90 percent of the new LNP transmission lines with existing PEF transmission-line corridors (PEF 2009d) would reduce the potential for additional avian collision and electrocution. No new transmission lines are proposed under the proposed operating license extension or power uprate for CREC Unit 3. Vegetation control within transmission-line corridors can have both adverse and beneficial effects on wildlife. While periodic vegetation control can result in incidental wildlife mortality, species that inhabit early successional habitat (including emergent and scrub-shrub wetlands) or use edge environments would benefit from the maintenance of these habitat conditions. These planned transmission-line operation and maintenance practices would be expected to have only minimal cumulative effects on wildlife, whether adverse or beneficial.

In the State of Florida's Conditions for the LNP Site Certification, CREC Units 1 and 2 (fossil-fuel plants) would be decommissioned assuming LNP Units 1 and 2 are licensed, constructed, and begin operation in a timely manner (FDEP 2010a). This decommissioning would be expected to provide only minimal beneficial impacts on terrestrial resources because the area would likely remain industrial.

7.3.1.2 Important Species

Important terrestrial species meeting the NRC criteria are identified and discussed in Sections 2.4.1.3 and 2.4.1.4. Future urban, industrial and utility development, new transmission-line corridors, and the effects of future changes in climate may potentially affect important species that occur near the LNP project primarily by decreasing or degrading the available habitat for these species. As described above, habitat loss may occur through loss of upland and wetland habitats from urban or agricultural development, quarries, sea-level rise, increasing salinity of estuarine areas, and inundation or filling of wetland habitats. Sea-level rise resulting from climate change along the Gulf Coast of Florida could accelerate the loss of wetlands and estuaries, thus eliminating breeding and foraging habitat for commercial, game, and threatened and endangered wildlife (Ning et al. 2003; GCRP 2009). Loss or alteration of habitats could affect many of the Federally and State-listed plant species that may occur near the LNP project (see Table 2-8).

Populations of a number of Federally and State-listed birds use tidal marshes and estuaries along the Florida Gulf Coast in the area near the LNP project. Examples, among others noted in Table 2-8, include Scott's seaside sparrow (*Ammodramus maritimus*), piping plover (*Charadrius melodus*), and American oystercatcher (*Haematopus palliatus*), as well as several wading bird species. Threats posed to these species include the loss or degradation of foraging habitat and the loss of breeding habitat as a result of sea level rise and increased salinity caused by climate change. Nesting habitat for the brown pelican (*Pelecanus occidentalis*) along the Florida Gulf Coast might also be altered or inundated by sea level rise due to changing climate.

Numerous other Federally and State-listed birds may occur within or adjacent to the predominantly inland areas near the LNP project (see Table 2-8). Wading birds such as the wood stork, little blue heron, and white ibis would be affected by development activities that alter or destroy wetland and marsh habitats where birds nest or forage. Examples of such development include activities associated with the LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, increased urbanization, etc). Activities that generate noise such as mining or operation of heavy machinery could affect or disturb rookeries where these birds breed. Removal of mature pine forest could degrade breeding and foraging habitat for red-cockaded woodpeckers, and clearing oak scrub habitats could affect Florida scrub jay.

Federally and State-listed reptiles and amphibians could be affected by projects involving land-clearing (such as development of LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, increased urbanization, etc), habitat loss or fragmentation (such as new transmission line corridors or expansion of US 19, Sun Coast Toll Road, or the FGT pipeline), wetland fill or degradation, and increased vehicle traffic on roads and right-of-ways. Species that may occur near the LNP site wherever suitable habitat is present include the gopher tortoise, Florida pine snake (*Pituophis melanoleucus mugitus*), sand skink (*Neoseps reynoldsi*), short-tailed snake (*Stilosoma extenuatum*), eastern indigo snake (*Drymarchon corais*) and gopher frog (*Rana capito*) (Table 2-8). The Eastern indigo snake, Florida pine snake, and gopher frog are often commensal with the gopher tortoise, using the tortoise burrow systems for shelter. These species could be displaced and would likely suffer increased mortality. The American alligator (*Alligator mississippiensis*), listed as threatened under the ESA (due to similarity of appearance to the American crocodile, *Crocodylus acutus*) is found in areas near the LNP site, but is considered to have fully recovered (52 FR 21059). Although trends and conditions, such as urbanization, industrialization, and global climate change, could affect the American alligator's habitat and local distribution, none of the identified present or future projects is expected to affect this recovered species.

Four State-listed mammals are identified from areas near the LNP site: the Florida mouse (*Podomys floridanus*), Homosassa shrew (*Sorex longirostris eionis*), Sherman's fox squirrel (*Sciurus niger shermani*), and Florida black bear (*Ursus americanus floridanus*). All could be affected by the loss or degradation of suitable habitat by development (such as development of LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, etc.). The Florida mouse is often commensal with the gopher tortoise, seeking shelter in tortoise burrow systems. The less mobile Florida mouse and Homosassa shrew would be at greater risk of incurring mortality during land clearing, while black bear and Sherman's fox squirrel would be displaced to adjacent communities. Habitat fragmentation could adversely impact

Florida black bear, which require expansive tracts of forest and wetlands to persist. Persistence of such species in this area could eventually depend on proper management of the remaining large tracts of protected land.

The creation and maintenance of new utility corridors, including those for LNP transmission lines, the FGT pipeline, and expansion of US 19 and the Sun Coast Toll Road, would be beneficial for some important species that use early successional habitat or edge environments, such as white-tailed deer, bobwhite quail, gopher tortoise, and Florida burrowing owl. Local populations of game species may be temporarily affected by development activities. During land clearing activities habitat may be lost, and game species could be displaced during clearing and grading. However, because many game species are habitat generalists, they are expected to adapt readily to changed landscape conditions. Vegetation control and other maintenance practices within transmission-line rights-of-way could be harmful to gopher tortoises if protective measures are not taken in areas occupied by this species.

New transmission-line and other utility corridors would contribute to habitat fragmentation, which could reduce habitat for species that require large unfragmented tracts of suitable habitat such as red-cockaded woodpeckers, Florida black bear and eastern indigo snakes. Building new transmission lines and corridors would also present an increased mortality risk from avian collision and electrocution for large important species such as bald eagles, Florida sandhill cranes, herons and egrets. Large structures, transmission lines and nighttime lights associated with future projects may also pose a mortality hazard for protected species that use the branch of the Eastern Atlantic Flyway that crosses northern and central Florida (FWS 2010; Birdnature.com 2009). Although these potential collision hazards generally have little effect on population levels for common bird species, impacts on less common bird species may be more substantial. Because none of the potentially affected bird species are endemic to the geographic area of interest, it is unlikely that the collision impacts would pose a risk to the overall survival of any avian species, including the less common species.

As many as 76 species of Federally and State-listed plants may occur near the LNP site wherever suitable habitat is present (Table 2-8). Proposed projects that involve clearing and grading could remove individuals of listed plants if suitable habitats are disturbed, especially species requiring forest habitats. However, creation of new utility corridors could provide new habitat for some listed plants favoring herbaceous and scrub instead of forest cover if vegetation-maintenance practices are adapted to benefit any populations that establish.

7.3.1.3 Summary of Cumulative Impacts on the Terrestrial Ecosystem

Cumulative impacts on terrestrial ecology resources are estimated based on the information provided by PEF and the review team’s independent evaluation. Past, present, and reasonably foreseeable future activities exist in the geographic area of interest that could affect terrestrial ecological resources in ways similar to the proposed LNP project. Development and expansion of transmission-line corridors and infrastructure to support proposed future projects would likely affect wildlife and may be detrimental to native upland and wetland habitats. Loss of wildlife habitat, increased habitat fragmentation, impacts on important species, and increased loss of wetlands and other habitats from continued development, such as new roads and pipelines, and as a consequence of climate change are unavoidable and would continue to occur. Alteration or loss of habitat, increased habitat fragmentation, and increased risk of avian collision and electrocution within a branch of the Eastern Atlantic Flyway would contribute to the cumulative impacts. Based on this analysis, the review team concludes that cumulative impacts from construction, preconstruction, and operations of the proposed LNP units and from other past, present, and reasonably foreseeable future actions on wildlife, important species and their habitats would noticeably alter, but not likely destabilize, terrestrial ecological resources in the surrounding landscape.

The review team therefore concludes that the cumulative impacts to terrestrial resources from past, present, and reasonably foreseeable future actions in the geographic area of interest would be MODERATE. This determination is based primarily upon the extent of expected wetland loss, fragmentation of wetland and upland forest habitats, and continued widespread manipulation of habitats for commercial forest management. The incremental impacts from NRC-authorized construction and operation activities would be SMALL to MODERATE, primarily due to the possible effects of groundwater withdrawal on nearby wetlands and associated biota. Although incremental impacts on terrestrial resources could be noticeable near the LNP project, these impacts would not be expected to broadly destabilize the overall ecology of the regional landscape.

7.3.2 Aquatic Ecosystem Impacts

The description of the affected environment in Section 2.4.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.3.2, the NRC staff concludes that the impacts of NRC-authorized construction activities on aquatic biota would be SMALL, and no further mitigation would be warranted. Similarly, as described in Section 5.3.2, the review team concludes that the impacts of operations on aquatic biota would be SMALL, and no further mitigation would be warranted.

The combined impacts on aquatic resources from construction and preconstruction were described in Section 4.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and future actions that could affect aquatic ecology. For this analysis, the geographic area of interest is the waterbodies connected to the proposed LNP site and offsite facilities, the entire CFBC, Lake Rousseau, the Inglis Lock bypass channel, the OWR, the CREC intake and discharge, and the Levy and Citrus Counties offshore areas of the Gulf of Mexico. The proposed transmission-line corridors are also included in the geographic area of interest. Other nearby watersheds, such as the Waccasassa River basin, do not affect water quality or biota in the waterbodies associated with LNP activities and are therefore not considered in the cumulative impacts analysis.

Other actions in the vicinity that have present and reasonably foreseeable future potential impacts on the CFBC and Gulf of Mexico offshore of the CREC include continued operation of the existing CREC, the proposed power uprate of CREC Unit 3, current operation of the Inglis Quarry, widening of the US-19 bridge across the CFBC, a proposed hydropower project on the Inglis Lock bypass channel spillway, the proposed Tarmac King Road Limestone Mine, decommissioning of CREC Units 1 and 2, development of a Port District along the CFBC, and natural environmental stressors (e.g., short- or long-term changes in precipitation or temperature and the resulting response of the aquatic community).

Historically, the construction and operation of CREC Units 1–5 have had some impact on fisheries in the Gulf of Mexico, which PEF mitigates by hatchery supplementation. The Crystal River Mariculture Center began operation October 1991, with red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), and pink shrimp (*Farfantepenaeus duorarum*) among the primary species cultured. Other species such as pinfish (*Lagodon rhomboides*), pigfish (*Orthopristis chrysoptera*), stone crab (*Menippe mercenaria*), and blue crab (*Callinectes sapidus*) are also cultured and released in the Gulf of Mexico (PEF 2009e). Between 1999 and 2005, 8 loggerhead sea turtles (*Caretta caretta*), 38 green sea turtles (*Chelonia mydas*), 1 hawksbill sea turtle (*Eretmochelys imbricata*), and 92 Kemp's ridley sea turtles (*Lepidochelys kempii*) have been collected at CREC (Eaton et al. 2008). PEF currently has an incidental take permit from NMFS that allows an incidental live take of up to 75 sea turtles annually, 3 annual causal sea turtle mortalities, and a reporting requirement for non-causal related mortalities of 8 or more within a 12-month period (NMFS 2002). PEF has an ongoing program to monitor the intake canal for the presence of sea turtles, perform rescues for stranded individuals, provide rehabilitation, and release resources when possible. In 2000, NRC found no significant impact on marine turtles from the operation of CREC Unit 3 (NMFS 2002).

The current CFBC was constructed starting in 1964, but was never completed as a cross-Florida canal and was officially deauthorized in 1991 (Noll and Tegeder 2003). The western portion of the completed CFBC extends from the Gulf of Mexico to the Inglis Lock at Lake Rousseau, and is typical of a tidal canal with marine and estuarine characteristics. Currently, portions of the CFBC are managed as a protected greenbelt corridor as part of the Marjorie Harris Carr Cross Florida Greenway (Noll and Tegeder 2003).

Cumulative impacts on aquatic resources within the CFBC may also include activities or events that are distinct from the LNP site. Activities related to construction of the hydropower system on the Inglis Lock bypass channel could temporarily affect the downstream migration of fish from Lake Rousseau to the Withlacoochee River, but would not affect the CFBC or OWR. The US-19 bridge expansion would not include in-water construction, and impacts on the CFBC would likely be mitigated through best management practices (BMPs) to control erosion and stormwater runoff during bridge construction. The Inglis Quarry is located on the north side of the CFBC. Drainage ditches, associated with the quarry are separated from the CFBC by a containment berm (SDI 2008). Barge traffic within the CFBC is likely to be limited to LNP module transportation, and should have minimal impact on aquatic resources as discussed in Section 4.3.2. The proposed Tarmac King Road Limestone Mine expansion may affect groundwater discharge to the lower Withlacoochee River as discussed in Section 7.2.1.2. As described in Section 4.2.1, the probable impact on overall reduction in groundwater flux due to the establishment of this mine through the region is expected to be small. The CREC Unit 3 power uprate is not expected to have any construction-related impacts except for those related to the construction of additional mechanical draft cooling towers on the CREC site on land that has been previously disturbed. Any onsite potential construction-related impacts would be mitigated through the use of BMPs. The contribution of LNP construction-related impacts to impacts related to other nearby construction activities would be minor. Impacts from construction of LNP would be temporary and minor, largely mitigated, and mainly confined to the site. Therefore, the staff concludes that the overall contribution of LNP construction to cumulative losses of aquatic organisms in the region would be minor.

For operations, the review team considered the potential cumulative impacts on the Gulf of Mexico and CFBC related to impingement and entrainment of aquatic organisms and also thermal and chemical releases from both CREC and LNP. Water withdrawn for operation of proposed LNP Units 1 and 2 would require a net intake of 190 cfs (122 Mgd). The source of the 190 cfs, under low flow conditions, would be 50 cfs from leakage of Lake Rousseau water through the Inglis Lock and freshwater springs, emanating in the CFBC in the vicinity of the intake structure; 70 cfs from the discharge of Lake Rousseau water at the Inglis Dam that would enter the CFBC via the OWR; and an inflow of 70 cfs that would come from the Gulf of Mexico.

Currently, CREC Units 1–5 withdraw over 15 times more water from the Gulf of Mexico for operations than the required 190 cfs for LNP Units 1 and 2. The proposed CREC Unit 3 uprate would not increase station water intake flow for CREC Units 1, 2, and 3 (PEF 2007). The additional waste heat generated as a result of the CREC Unit 3 power uprate would be dissipated to the atmosphere by the additional mechanical draft cooling tower planned for construction at the CREC site.

The review team considered the potential incremental cumulative impacts of impingement and entrainment of aquatic organisms related to operation of LNP 1 and 2 along with continued operation of CREC Units 1–5. As discussed in Section 5.3.2, the proposed closed-cycle cooling system with mechanical draft cooling towers for proposed LNP Units 1 and 2 would not be expected to result in a discernable impact on populations of aquatic organisms inhabiting Crystal Bay and Withlacoochee Bay areas of the Gulf of Mexico as a result of impingement or entrainment.

The review team is aware that the possibility exists that CREC Units 1 and 2 (fossil-fuel plants) which contribute significantly to the overall impingement and entrainment of aquatic organisms at CREC, would be decommissioned once LNP Units 1 and 2 begin operation. This significant reduction in intake withdrawal volume (greater than 48 percent) at CREC would reduce the cumulative impact of impingement and entrainment related to operation of CREC on aquatic organisms in the Gulf of Mexico, and may result in a net positive impact on local fisheries.

The operation of the proposed Inglis hydropower project would involve the use of bar racks to prevent debris and organisms larger than 2 in. from traveling through the turbine (Inglis 2008). Any potential impacts from the Inglis hydropower project are isolated from the impacts on the CFBC because the Inglis Lock bypass channel and Withlacoochee River are not hydraulically connected to the CFBC. The construction and operation of the hydroelectric facility would have no effect on populations of aquatic organisms inhabiting the CFBC. Therefore, the Inglis hydroelectric project would have no detectable incremental cumulative impact on aquatic resources affected by the building and operation of LNP.

The review team also considered the potential cumulative impacts of thermal discharges. The operation of all five units at CREC with the uprate of CREC Unit 3, and without the LNP Units 1 and 2 discharge would result in no thermal increase with the operation of a new helper cooling tower to augment the current modular helper cooling towers (PEF 2007). The review team is aware that the possibility exists that CREC Units 1 and 2 (fossil-fuel plants) which contribute to the discharge flow, would be decommissioned once LNP Units 1 and 2 begin operation. The staff conducted a thermal analysis of two cases involving the discharge from CREC.

The first case evaluated the thermal discharge from all five units at CREC, the power uprate from CREC Unit 3 and the blowdown from LNP Units 1 and 2. A second analysis involved CREC Units 3 through 5, the Unit 3 power uprate, blowdown from LNP 1 and 2 and CREC Units 1 and 2 permanently shutdown. The thermal analyses for these two cases are presented in Section 5.2.3.1.

The first scenario concludes that resulting changes in discharges at CREC would be minimal for thermal and chemical impacts with a slight increase in discharge plume size. The addition of the LNP Units 1 and 2 discharge would result in an increased discharge volume of 87.93 Mgd, but no significant increase in thermal plume temperature or salinity over current conditions, as discussed in Section 5.3.2.1.

The second scenario, with CREC Units 1 and 2 not operating, CREC Units 3 through 5 operating, CREC Unit 3 with the power uprate, and LNP Units 1 and 2 operating, would result in a discharge plume much decreased in size when compared to the first scenario. CREC Units 1 and 2 currently contribute 918 Mgd total discharge to the Gulf of Mexico during summer operations. This accounts for greater than 45 percent of the total CREC discharge (PEF 2009b). The predicted thermal plume would decrease during both summer and winter conditions as a result from the decreased discharge plume. Salinity increases would occur under both summer and winter conditions due to increased cycles of concentration with CREC Units 1 and 2 non-operational, but are less than 1.0 psu.

Both scenarios represent a noticeable temperature and salinity change in the immediate Gulf of Mexico waters compared to the same region prior to CREC operations from a cumulative point of view (as discussed in Section 7.2.2.1). However, habitats and aquatic organisms in this area have adapted to the salinity and temperature changes so that the incremental impacts of LNP 1 and 2 discharge, CREC uprate of Unit 3, and decommissioning of CREC Units 1 and 2 would likely not be noticeable.

The review team considered the potential cumulative impacts from chemical releases, including increases in total dissolved solids in the combined CREC and LNP discharge. CREC Units 1–5 are in compliance with the Federal Water Pollution Control Act (also referred to as Clean Water Act) (33 USC 1251, et seq.) Section 316(a) (thermal discharges) impacts from cooling-water systems. Chemical releases from the existing unit(s) currently comply with the FDEP NPDES permitting requirements, and compliance with the Unit 3 uprate, and decommissioning of CREC Units 1 and 2 is expected to continue and would be monitored in the future. The FDEP will take cumulative chemical releases from the existing and proposed unit(s), as well as from other industrial sites discharging to the Gulf of Mexico into consideration before approving a NPDES permit for the proposed unit(s). Given the lack of other discharges into the immediate area of the CREC discharge, it is likely that the cumulative impacts from LNP discharge combined with the discharge from CREC Units 1 through 5 with and without operation of CREC Units 1 and 2 would be minimal.

Nutrients introduced to groundwater from natural or manmade events such as fires may affect nutrient loading in surface waters. Nutrients would be discharged to groundwater through infiltration of surface waters located as stormwater-detention ponds on the LNP site and are not expected to affect offsite waterbodies such as the Withlacoochee River or Lake Rousseau. Furthermore appropriate stewardship of the site by the applicant is expected to significantly reduce the potential for uncontrolled fires involving onsite vegetation.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development, such as the proposed Port District, for commercial, industrial, and residential waterfront development along the CFBC to the west of US-19 (Citrus County 2009), increased water needs, and increased discharge of effluents into the Gulf of Mexico or the CFBC. The review team is also aware of the potential for global climate change affecting aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change could result in sea level rise and may cause regional increases in the frequency of severe weather, decreases in annual precipitation and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the CREC site through changes in species diversity, abundance and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but specific predictions on aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities. Aquatic ecosystem responses to these events are difficult to predict. Although trends and conditions, such as urbanization, industrialization, and global climate change, could affect aquatic species habitats, none of the identified present or future projects is expected to adversely affect aquatic species in the geographic area of interest.

Cumulative impacts on aquatic ecology resources are estimated based on the information provided by PEF and the review team's independent review. As noted above, the review team found the cumulative impacts from both construction and operation to be minimal. Due to the minimal nature of these impacts, when combined, the review team concludes that cumulative impacts on aquatic biota from the construction, preconstruction, and operation of LNP Units 1 and 2 and other past, present, and reasonably foreseeable projects would be SMALL.

7.4 Socioeconomics and Environmental Justice

The evaluation of cumulative impacts on socioeconomics and environmental justice is described in the following sections.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as a baseline for the cumulative impacts assessment in these resource areas. As described in Section 4.4, the NRC staff concluded that the socioeconomic impacts of NRC-authorized construction activities would be SMALL with exceptions discussed as follows. The NRC staff found that specific community public services were either at capacity or otherwise limited in some areas and concluded that the impacts of NRC-authorized construction activities would include MODERATE impacts on Inglis and Dunnellon police and emergency services and Levy County fire-protection services and MODERATE impacts on schools serving Inglis, Yankeetown, and Dunnellon during peak employment years. Aesthetic impacts near the LNP site would be SMALL, although localized MODERATE impacts would be felt along newly cleared transmission-line corridors. The review team anticipates SMALL impacts from NRC-authorized construction and preconstruction of the LNP on the existing road network, with the exception of the intersection of US-19 and the construction driveway where impacts would be MODERATE and intermittent.

As described in Section 5.4, the review team determined that the physical and demographic effects of plant operations would be SMALL. Economic and tax impacts would be SMALL and beneficial except for Levy County where tax impacts would be LARGE and beneficial. Impacts on infrastructure, transportation, and community services would be SMALL except for short-term MODERATE impacts on police and emergency services in Inglis and Dunnellon; fire-protection services in Levy County; and schools serving Inglis, Yankeetown, and Dunnellon. The review team determined that in the long term once local funding has been adjusted, all of these MODERATE impacts would reduce to SMALL. Aesthetic impacts near the LNP site would be SMALL, although localized MODERATE impacts would be felt along transmission-line corridors.

The impact analyses in Chapters 4 and 5 are cumulative by nature. The combined impacts from construction and preconstruction were described in Section 4.4 and were determined to be the same as described above for NRC-authorized activities. In addition to socioeconomic impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative socioeconomic impacts. For this cumulative impacts analysis, the geographic area of interest is considered to be the region (i.e., the 50-mi radius around the LNP site). The review team determined the region includes the primary communities and three counties – Marion, Levy, and Citrus – that make up the Economic Impact Area (EIA) that would be most affected by the proposed project.

For more than a century, the LNP site has been used for forest plantation. Most of the LNP site would be preserved in its present forested condition with forest surrounding the industrial area. The closest residential properties are located 1.6 mi northwest and 1.7 mi west-southwest of the site. There are no sensitive populations near the LNP site. The nearest recreational resources are Goethe State Forest, the Marjorie Harris Carr Cross-Florida Greenway, Inglis Island Trail, Inglis Lock Recreation Area, and the CFBC.

In 2000, approximately 2 percent of the resident population of the region lived within 10 mi of the proposed LNP site. The remaining 98 percent lived between 10 mi and 50 mi of the proposed site. The resident population within 10 mi of the proposed site is concentrated in and around the communities of Yankeetown, to the west-southwest of the proposed site; Inglis, to the southwest; and Dunnellon, to the east. Within the wider region, the resident population is concentrated around the cities of Gainesville, to the north-northeast; Crystal River, to the south; and Ocala, to the east-northeast. In the EIA, Levy County is the least populated and most rural, followed by Citrus County, which gained population and urban development following construction of the CREC. Marion County is the most populated and least rural. All school districts in the EIA reported trends in school enrollments that indicated increasing populations of retired persons in the late 1990s and early 2000s, and all projected a continuation of that trend before the economic downturn of 2008–2009.

Projects and plans that have contributed to existing conditions around the LNP site, in the EIA, and in the region include those listed in Table 7-2. They have affected demography, economy, and community infrastructure in the region as it exists today. The table presents some likely effects based on the review team's understanding of similar projects and on information

Table 7-2. Contributions of Past Projects to Current Conditions

Project	Likely Contributions Present Socioeconomic Conditions
CREC	• In-migrating construction and operations workers affecting demography, employment, and associated revenues from direct and indirect jobs, as well as demand for housing and community infrastructure – noticeable and character-changing impact in Citrus County evidenced in new planned residential developments, increased school capacity over time, and interviewees' comments that Citrus County had been like Levy County before the CREC was built. • Property tax revenues enabling development of community infrastructure.
Construction of CFBC	• Typical short-term impacts of large construction project – minor effects on demography; minor beneficial effects on employment and associated revenues.
Improvements to Federal, State, and county roads	• Typical short-term impacts of medium- and large-construction projects – minor effects on demography; minor beneficial effects on employment and associated revenues. • Improved access to jobs and community infrastructure for residents and visitors – minor effect on demography; minor beneficial effects on employment and associated revenues.
Water- and/or wastewater-treatment and distribution facilities	• Enabling increased and more dense residential development – minor to noticeable effects on demography.
County comprehensive plans	• Preserving rural quality of life by design – noticeable effect on demography.

provided during interviews with local officials. The information in the table suggests that county comprehensive plans have had a noticeable impact on current conditions region-wide by controlling the nature of development and residential settlement. Construction of the CREC also had a noticeable impact, particularly in Citrus County where conditions now are reportedly much different from what they were before the facility was constructed (NRC 2009). As indicated, these effects are reflected in current capacities and conditions presented in Section 2.5.

Within the region, the two reasonably foreseeable projects shown on Table 7-1 with the greatest potential to affect cumulative socioeconomic impacts would be the Tarmac King Road Limestone Mine during preconstruction and construction of LNP and the closure of two of the four coal-fired units at CREC during operation of LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The review team believes the effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes.

Tarmac has applied for permits to begin construction of the King Road Limestone Mine in 2010 with operations beginning in 2012. Tarmac estimates that at the height of mining activity, about

500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). The potential impacts from this increased traffic, coupled with traffic from the LNP site, were considered in Sections 4.4 and 5.4 and were considered minor except during the highest traffic periods, such as shift changes, when road congestion would create noticeable, intermittent impacts.

The closure of two of the four coal-fired units at CREC that is expected to occur after the proposed two units at the LNP site are operating (FDEP 2010a), would potentially extend employment for some of the construction workers temporarily, moderating the impact of the loss of operations jobs at CREC. In the longer term, the closure-related employment and income losses would magnify the differential between peak construction and long-term employment in the EIA and the associated population loss and decrease in demand on infrastructure and community services. To some extent, these effects would be offset by employment and population gains associated with operation of LNP, although more jobs would be lost at the coal-fired units than gained at LNP. Assuming no offset, the percentage employment and associated population lost would be less than 1 percent of employment and population in the EIA, a loss that the review team determined would be noticeable only in the most directly affected communities. In addition, Citrus County would see a potential loss in tax revenue paid by PEF for the coal-fired units at CREC that would not be offset by taxes paid by PEF for the LNP units, because these taxes would be paid to Levy County. Because Citrus County would still receive tax revenue from PEF for the remaining nuclear unit and two coal units at CREC, the review team determined that the lost revenue would be minor and not sufficient to alter Citrus County's ability to provide infrastructure and community services to its population.

Based on the preceding analysis, the review team found that the reduction of tax revenue associated with the possible closure of two of the four CREC coal-fired units could noticeably alter the economy for Citrus County. The review team did not indentify other projects that would significantly contribute to cumulative socioeconomic effects beyond those identified in Chapters 4 and 5. Thus, the team determined that cumulative socioeconomic effects of the LNP project and other past, present, and reasonably foreseeable projects would be SMALL with the following exceptions: there would be MODERATE short-term adverse effects on police, emergency service, fire-protection services, and schools in specific local communities during peak construction and preconstruction employment years, and SMALL with a MODERATE and intermittent impact on one transportation corridor. The short-term adverse effects would be expected to become SMALL once local funding has been adjusted after a few years of LNP operation. Levy County would see long-term LARGE beneficial tax impacts after LNP begins operation. Citrus County would see SMALL adverse tax impacts after coal-fired units at CREC are closed. There would be long-term MODERATE aesthetic impacts along transmission-line corridors.

Based on the preceding conclusions and because NRC-authorized construction and operations activities represent only a portion of the analyzed activities, the NRC staff concludes that the cumulative impacts of NRC-authorized construction and operations activities would be SMALL (with the noted exceptions). The review team's finding of MODERATE adverse impacts during the building of LNP was based on the fact that specific community public services were either at capacity or otherwise limited. Consequently, any increase in demand for services would result in a noticeable impact. As discussed, the review team expects these impacts would reduce to SMALL during operation of LNP. The NRC staff found that the cumulative LARGE beneficial tax impact on Levy County would be due to NRC-authorized construction, while the cumulative SMALL adverse tax impact on Citrus County would not be due to NRC-authorized activities.

7.4.2 Environmental Justice

The description of the affected environment in Sections 2.5 and 2.6 serves as a baseline for the cumulative impacts assessment of environmental justice impacts. The combined physical and socioeconomic impacts from construction and preconstruction and from operations are summarized in Sections 4.5.4 and 5.5.4. Adverse physical and socioeconomic impacts were determined to be SMALL for most elements and MODERATE in the short term for education and police, emergency, and fire-protection services in certain locations, and SMALL for all elements in the longer term, once local funding has been adjusted. As discussed in Sections 4.5 and 5.5, the review team concluded that no disproportionately high and adverse impacts on minority and low-income populations would result from NRC-authorized construction activities or from operation of LNP. Therefore, environmental justice impacts would be SMALL.

In addition to environmental justice impacts from preconstruction, construction, and operation of LNP, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative environmental justice impacts. For this cumulative analysis, the general geographic area of interest is considered to be the 50-mi region described in Section 2.5.1.

As shown in Figure 2-26, all census block groups with minority and low-income populations that meet the criteria discussed in Section 2.6 are located 10 mi or farther away from the LNP site. The closest minority populations (both aggregate and African-American) are in Citrus County between Citrus Springs and Dunnellon, approximately 10 mi from the site. The closest low-income populations, near Otter Creek in Levy County, are almost 20 mi from the site. There are concentrations of block groups with African-American populations around the communities of Otter Creek, Usher, Chiefland, and Williston in Levy County between 20 and 30 mi from the site; around Ocala in Marion County, about 30 mi from the site; around Gainesville in Alachua County, about 45 mi from the site; and in the northwest corner of Sumter County, between 20 and 30 mi from the site. (Note: These are linear distances from the LNP site center; driving distances to all communities are greater). There are concentrations of block groups with low-income populations that overlap with African-American populations around Otter Creek, Usher, and Chiefland in Levy County and around Ocala (Marion County) and Gainesville (Alachua County).

As discussed in Section 7.4.1 for socioeconomic cumulative impacts, the two reasonably foreseeable projects shown on Table 7-1 with the greatest potential to affect cumulative environmental justice impacts within the region would be the Tarmac King Road Limestone Mine during preconstruction and construction of LNP and the closure of coal-fired units at CREC during operation of LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The review team believes the effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes.

As explained in Section 7.4.1, the potential impacts from increased traffic associated with the new limestone mine, coupled with traffic from the LNP site, were considered in Sections 4.4 and 5.4 and, as mentioned, were considered minor except during shift changes with no disproportionately high and adverse impacts on low-income and minority populations.

After construction, the region would experience reduced direct construction employment and related indirect jobs. This reduction would be somewhat offset by the introduction of new operations workers at the new units. The planned closure of two of the four coal-fired units at CREC that is expected to occur after the proposed two nuclear power units are operating would slightly increase the differential between peak construction and long-term employment. In addition, Citrus County would see a loss in tax revenue paid by PEF for the two coal-fired units at CREC; however, the review team determined the loss in revenue would not be destabilizing given the new revenue from the two nuclear units and other remaining revenue sources. If the operating license for the existing nuclear unit at CREC were not renewed (it is currently valid through midnight December 3, 2016) and the unit closed, the loss of employment, income, and tax revenues would be larger. The review team found no evidence that these socioeconomic impacts would have a disproportionately high and adverse affect on low-income or minority populations in the region. The review team also found no evidence that impacts described in the other sections of this chapter (i.e., impacts to land use, water use and quality, ecology, historic and cultural resources, air quality, health; and impacts of waste, postulated accidents, fuel cycle transportation and decommissioning) would have a disproportionately high and adverse affect on minority or low-income populations in the region.

Based on the analysis above, the review team determined that cumulative environmental justice impacts of preconstruction, construction, and operation of LNP and other past, present, and reasonably foreseeable projects would be SMALL and that the environmental justice impacts impacts from NRC-authorized activities in combination with the other projects described in Table 7-1 would be SMALL.

7.5 Historic and Cultural Resources

The description of the affected environment in Section 2.7 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.6, impacts on cultural resources from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.6, the review team concludes that the impacts on cultural resources from operations are SMALL. Mitigation may be warranted only in the event of an unanticipated discovery during any ground-disturbing activities associated with construction or maintenance of the operating facility. These actions would be determined by PEF in consultation with the Florida State Historic Preservation Office (SHPO). PEF's cultural resource management procedures would be followed if it encountered cultural resources during building and operation (PEF 2008c).

The combined impacts from preconstruction and construction are described in Section 4.6 and were determined to be SMALL. If preconstruction activities associated with the transmission lines result in significant alterations to the known cultural resources in the transmission-line corridors, then the impact could be greater. The known cultural resources located in the transmission-line corridors are described in Section 2.7.2.4 and consist of one National Register of Historic Places (NRHP)-eligible site (8SM128) and two sites having confirmed or potential human remains (8SM10 and 8SM84). In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable projects that could affect historic and cultural resources. The geographic area of interest for this assessment of potential cumulative impacts includes the direct and indirect Areas of Potential Effect (APEs) for cultural resources at the LNP site, which are defined in Section 2.7, and the transmission-line corridors. The cumulative impacts assessment considers the eligibility of historical properties for listing in the NRHP (National Register). Coordination with the SHPO provided information on cultural resources and potential impacts on cultural resources with respect to other past, present, and reasonably forseeable future actions in the geographic area of interest.

The cultural background for the LNP site is described in Section 2.7.1. Historically, several groups of American Indians lived in Florida, many of which became extinct or merged with other groups due to non-American Indian encroachment by explorers and settlers by the mid-1700s. The largest groups were the Miccosukee Tribe of Indians and the Seminole Tribe of Florida. Conflict between settlers and the Seminoles was defined by warfare and slave raids until the mid-19th century, by which time conflict and disease had contributed to the near-extinction of the Seminoles. By 1858, at the end of the third Seminole War, only 200 Seminoles remained. Nine forts were reportedly established in Levy County as part of the conflict with Native Americans in the region with the Second and Third Seminole Wars. During the Civil War, the Cedar Key port was occupied by both northern and southern troops. The town nearest to the

LNP project area was first recorded as Black Dirt in 1860. Over the next 30 years, its name changed from Black Dirt to Blind Horse, then to Inglis.

Projects within the geographic area of interest that may have a potential cumulative impact on cultural resources include Goethe State Forest and future urbanization such as the expansion or creation of roads or pipelines near or intersecting the proposed transmission lines. Development in the Goethe State Forest is unlikely; however such projects could affect cultural resources if ground-disturbing activities occur or if new above-ground structures affect the visual APE. As described in Section 2.7, there are known cultural resources in the transmission-line corridors. Long linear projects such as new or expanded roads or the FGT pipeline project may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, impacts on cultural resources would be minimal. If activities associated with building the transmission lines or road or pipeline expansion projects result in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable. Therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative cultural resources impact from preconstruction, construction, and operation of two units at the LNP site, and other past, present, and reasonably foreseeable projects would be SMALL.

7.6 Air Quality

The description of the affected environment in Section 2.9 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.7, the impacts of NRC-authorized construction activities on air quality impacts would be SMALL, and no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts of operations on air quality would be SMALL, and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction are described in Section 4.7 and were determined to be SMALL. In addition to the impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on air quality. For this cumulative analysis of criteria pollutants, the geographic area of interest is considered to be Levy County within the West Central Florida Intrastate Air Quality Control Region (40 CFR 81.96). As set forth in 40 CFR 81.310, air quality attainment status for Levy County reflects the effects of past and present emissions from all pollutant sources in the region. Levy County is in attainment for all of the National Ambient Air Quality Standards.

The air quality impacts of site development for LNP Units 1 and 2 would be local and temporary. Generally, the distance from building activities to the site boundary would be sufficient to avoid significant air quality impacts. Permitted air emission sources at the proposed LNP site include the cooling towers. The emissions of particulate matter from the two cooling towers would exceed 100 T/yr, making these towers a major source of particulate matter. A Florida Air Quality Permit has been prepared and submitted to the State under PEF's Florida Site Certification Application (PEF 2008b). Of the projects listed in Table 7-1, the operation of the Tarmac King Road Limestone Mine is the only project with the potential to have significant impacts on air quality. The primary pollutant from the quarry is fugitive dust emissions (Florida Air Quality Permit 0750089-001-AC), and the level of dust emission would be regulated by the State (FDEP 2008). Other industrial projects listed in Table 7-1 would have *de minimis* impacts. Given that these other projects all have institutional controls and the LNP site is influenced by coastal wind patterns, it is unlikely that there would be a degradation of air quality of Levy County.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the U.S. Global Change Research Program (GCRP), it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one-third of the greenhouse gas emissions are the result of generating electricity and heat (GCRP 2009). This assessment is focused on greenhouse gas emissions.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7.1, 5.10.3, 6.1.3, and Appendix I. The review team has concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single nuclear plant are minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single source or combination of greenhouse gas emission sources must be placed in geographic context, as follows:

- The environmental impact is global rather than local or regional.
- The effect is not particularly sensitive to the location of the release point.
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, is small when compared to the total mass of greenhouse gases resident in the atmosphere.

- The total number and variety of greenhouse gas emission sources is extremely large and ubiquitous.

These points are illustrated in Table 7-3.

Table 7-3. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global Emissions	28,000,000,000[a]
United States	6,000,000,000[a]
1000 MW Nuclear Power Plant (including fuel cycle, 90 percent capacity factor)	400,000[b]
1000 MW Nuclear Power Plant (operations only, 90 percent capacity factor)	5000[b]
Average U.S. Passenger Vehicle[c]	5

(a) EPA 2009.
(b) Appendix I.
(c) FHWA 2006.

Assuming that LNP becomes operational in a timely manner, the coal-fired Units 1 and 2 at the CREC would be shut down by 2020 (FDEP 2010a). This action would lead to a reduction in the amount greenhouse gas emissions associated with the operation of these two coal-fired units and emissions associated with the coal fuel cycle.

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The previously referenced GCRP (2009) report provides a synthesis of the results of numerous climate-modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP report (GCRP 2009), the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable with or without the greenhouse gas emissions (including the possible reduction of emissions associated with the shutdown of Units 1 and 2 at the CREC) of the proposed project.

Consequently, the review team recognizes that greenhouse gas emissions, including carbon dioxide, from individual stationary sources and cumulatively from multiple sources can contribute to climate change, and the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary of Air Quality Impacts

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the LNP site and other projects would not be noticeable. With the exception of the particulate emissions from the cooling towers (which require a permit from the State of Florida), the LNP and other projects listed in Table 7-1 would have *de minimis* impacts. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable. The review team concludes that the cumulative impacts would be noticeable with or without the greenhouse gas emissions from the LNP site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL to MODERATE. The incremental contribution of impacts on air quality resources from building and operating proposed Units 1 and 2 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

7.7 Nonradiological Health

The description of the affected environment in Section 2.10 serves as a baseline for nonradiological health. As described in Section 4.8, the nonradiological health effects associated with building would include noise, criteria air pollutant and dust emissions from construction equipment, occupational injuries, and increased air emissions and traffic accidents associated with transporting workers and construction materials to and from the site. As discussed in Section 4.8.4, the NRC staff has concluded that the nonradiological health impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted other than that described in PEF's ER.

Nonradiological health impacts from LNP operation would include potential growth of thermophilic etiological agents in the cooling system, noise from the LNP and cooling-water intake pump, increased air emissions and traffic accidents, occupational injuries, and acute and chronic exposures to EMF from the transmission lines. As described in Section 5.8, the nonradiological health impacts from operation of the proposed LNP Units 1 and 2 would also be SMALL and warrant no further mitigation.

The review team has concluded that the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted other than that described in the ER (PEF 2009a). In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on nonradiological health (Table 7-1). For most of the nonradiological health impacts of facility construction and operation (air emissions, noise, occupational injuries), cumulative effects may occur only in areas very close to the LNP site. Occupational injuries would occur only on the LNP construction site, and there would thus be no potential for cumulative impacts with other projects.

For cumulative impacts associated with transmission-line corridors, the geographic area of interest is the transmission system associated with proposed LNP Units 1 and 2 (as described in Section 2.2.2). None of the present or future projects appears likely to have cumulative impacts on acute or chronic EMF exposure in or near the transmission-line corridors.

The review team considered the cumulative impacts associated with harmful thermophilic microorganisms in nearby waterbodies. The thermal contribution of LNP blowdown to the CREC discharge from Units 1 through 5, and assuming the Unit 3 power uprate, would be minor and would not increase the incidence of illness due to thermophilic microorganisms. The review team is aware that the total heat discharge from the CREC would be reduced if the two older coal-fired plants at the CREC are decommissioned, as required by the FDEP Conditions of Certification, assuming LNP Units 1 and 2 are licensed, constructed, and begin operations in a timely manner (FDEP 2010a). The operation of the proposed Inglis Lock project would not affect water temperature. Thus, the combined impact on thermophilic etiologic agents from LNP, CREC, and the proposed Inglis Lock project would be minimal.

Impacts of criteria air pollutants and fugitive dust during building and construction and noise from construction and operation have been assessed as minimal for the nearest offsite receptors located 1.6 and 1.7 mi from the center of the project site (see Sections 4.8.1, 4.8.2, and 5.8.2). Cumulative noise and air emission impacts from all but one of the current and future projects identified in Table 7-1 were considered to be minor because of the distance separating them from the LNP site. That one project is the Tarmac King Road Limestone Mine, which is approximately 2 mi to the west of the site. The combined noise or dust emission impacts from the LNP and the mine could possibly affect residents adversely. Combined impacts would most likely occur during LNP building activities. After the LNP begins operation, noise and particulate impacts from the LNP are predicted to be minimal, and the combined noise and air emission impacts from the LNP and the Tarmac Mine would be intermittent and minimal overall.

The review team is also aware of the potential climate changes that could affect human health. Information regarding the state of knowledge in this area (GCRP 2009) has been reviewed in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed LNP Units 1 and 2 include an increase in average temperature and a decrease in precipitation in the area of interest accompanied by an increase in severe weather events. Potential impacts of climate change that have been identified include the following:

- reduced cooling system efficiency at the LNP (and other power-generation facilities), which would result in increased temperature of the cooling-tower discharge water and possible increased growth of thermophilic, etiological agents
- increased incidence of diseases transmitted by food, water, and insects following heavy downpours and severe storms
- increased severity of water pollution associated with sediments, fertilizers, herbicides, pesticides, and thermal pollution caused by projected heavier rainfall intensity and longer periods of drought.

Potential increases in temperature and incidence of disease are of particular concern owing to the rapid growth of elderly population in Florida that may be particularly susceptible to these effects. While the effects of future climate change identified in these studies are not insignificant, their relationship to LNP operations is not clear, and the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases. While operation of the LNP might result in local increases in etiological agent growth, it is not clear that the operation of LNP would increase health risks owing to the strong controls on exposure to microbes (see Section 5.8.1).

Estimates of cumulative impacts on nonradiological health are based on information provided by PEF and the review team's independent evaluation of impacts resulting from the building and operation of the proposed LNP Units 1 and 2, along with a review of potential impacts from other past, present, and reasonably foreseeable projects located near the LNP site, CREC discharge, and the transmission-line corridor. The review team determined that the impacts from future projects that could affect nonradiological health impacts, including continued operations at CREC, the CREC Unit 3 uprate, and potential closure of two CREC coal-fired plants when the LNP Units 1 and 2 become operational, and global climate change, would be minimal. Therefore, the cumulative impacts of the LNP and other past, present and foreseeable future projects on public and worker nonradiological health would be SMALL, and mitigation beyond what is discussed in Sections 4.8 and 5.8 would not be warranted.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.11 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from operations would be SMALL, and no further mitigation would be warranted.

Cumulative Impacts

The combined impacts from construction and preconstruction are described in Section 4.9 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within the 50-mi radius of the LNP site. Historically, the NRC has used the 50-mi radius as a standard bounding the geographic area to evaluate population doses from routine releases from nuclear power plants. The geographic area of interest includes CREC Unit 3. Also within the 50-mi radius of the site, there are likely to be hospitals and industrial facilities that use radioactive materials.

As stated in Section 2.11, PEF has conducted a radiological environmental monitoring program (REMP) around CREC-3 since 1977. The program measures radiation and radioactive materials from all sources, including existing CREC Unit 3, hospitals, and industrial facilities. The staff review of the REMP reports found no indication of radiological consequence associated with the operation of CREC Unit 3.

As described in Section 4.9, the estimate of dose to construction workers during the building of proposed LNP Units 1 and 2 is well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. The estimate of doses to construction workers building proposed LNP Unit 2 includes Unit 1 as a source of exposure. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the LNP site are well below regulatory limits and standards. In addition, the dose to the maximally exposed individual from the LNP site and CREC Unit 3 (including any increased doses from the planned 20-percent power uprate) would be well within the regulatory standard of 40 CFR Part 190. Also, based on results of the CREC Unit 3 REMP and estimates of doses to biota given in Chapter 5.9, the NRC staff concludes that the cumulative radiological impact on biota would not be significant. The results of the REMP indicate that effluents and direct radiation from area hospitals and industrial facilities that use radioactive materials do not contribute measurably to the cumulative dose.

Currently, there are no other new nuclear facilities planned within 50 mi of the LNP site. The NRC, the U.S. Department of Energy, and the State of Florida would regulate or control proposed LNP Units 1 and 2 and any other reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts. Therefore, the NRC staff concludes that the cumulative radiological impacts of operating the proposed LNP Units 1 and 2, along with the existing CREC Unit 3 and the influence of other manmade sources of radiation nearby, would be SMALL, and mitigation would not be warranted.

7.9 Nonradiological Waste

Cumulative impacts on water and air from nonradiological waste are discussed in Sections 7.2 and 7.6, respectively. The cumulative impacts of nonradioactive waste destined for land-based treatment and disposal are primarily related to the available capacity of area treatment and disposal facilities and the amount of waste generated by the proposed project and other reasonably foreseeable projects.

During construction, offsite land-based waste treatment and disposal would be minimized by production and delivery of modular plant units, by segregation of recyclable materials, and by management of vegetative waste on site. Building activities would generate small quantities of construction debris, and the construction workforce would produce small quantities of municipal solid waste (MSW). Projects listed in Table 7-1 would generally either not coincide with the construction of the proposed LNP project (e.g., CREC Unit 3 uprate and potential closure of two CREC fossil fuel units) or would produce waste streams of a different nature (e.g., mining and park projects).

During operation, PEF estimates that the LNP would generate an average of 1617 T of nonradioactive, nonhazardous, solid waste annually (PEF 2008b), equivalent to less than 0.3 percent of the 573,000 T of MSW managed in Levy, Citrus, and Marion Counties in 2008 (FDEP 2009). As of 2006, Florida had 50 MSW landfills and 11 waste-to-energy plants, with additional landfill capacity being added (Biocycle 2008). Therefore, such impacts would be minimal.

PEF anticipates that LNP would be classified as a conditionally exempt small quantity generator (CESQG) or a small quantity generator (SQG) under the Resource Conservation and Recovery Act of 1976, as amended (RCRA) (42 USC 6901, et seq.). CESQGs and SQGs combined generate only 7 percent of the hazardous waste produced in Florida. No known capacity constraints exist for the treatment or disposal of hazardous wastes either within Florida or for the nation as a whole (FDEP 2007).

Of the projects listed in Table 7-1, only the renewal and uprate of CREC Unit 3 and the hospitals and industrial facilities that use radioactive material have the potential to generate mixed waste. None of the considered projects are expected to generate mixed waste in significant quantities above current rates, and therefore cumulative impacts would be minimal.

Based on the quantity of nonradioactive and mixed waste projected during LNP operation and the available treatment and disposal capacity, the review team concludes that cumulative impacts of nonradioactive and mixed waste would be SMALL, and additional mitigation would not be warranted.

7.10 Postulated Accidents

As described in Section 5.11.4, the staff concludes that the potential environmental impacts (risk) from a postulated accident from the operation of proposed LNP Units 1 and 2 would be SMALL. Section 5.11 considers both design-basis accidents (DBAs) and severe accidents.

As described in Section 5.11.1, the staff concludes that the environmental consequences of DBAs at the LNP site would be SMALL for an AP1000 reactor. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents.

As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risks) of an AP1000 reactor at the LNP site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted. The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within 50 mi of the proposed LNP Units 1 and 2. The 50-mi radius was selected to cover any potential risk overlaps from two or more nuclear plants. The only existing reactor within the geographic area of interest is CREC Unit 3.

Tables 5-18 and 5-19 in Section 5.11.2 provide comparisons of estimated risk for the proposed AP1000 units at the LNP site and current-generation reactors. The estimated population dose risk for the proposed AP1000 units at the LNP site is well below the mean and median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plant within the geographic area of interest, namely CREC Unit 3, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR 51, Appendix B, Table B-1). The planned 20-percent power uprate at CREC Unit 3 will only be approved by the NRC if the probability-weighted consequences of severe accidents would continue to meet NRC's regulatory requirements. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the LNP likely would be SMALL, and no further mitigation would be warranted.

7.11 Fuel Cycle, Transportation, and Decommissioning

The cumulative impacts related to the fuel cycle, radiological and nonradiological aspects of transportation, and facility decommissioning for the proposed site are described below.

7.11.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the impacts of the fuel cycle due to operation of proposed LNP Units 1 and 2 would be SMALL. Fuel-cycle impacts would occur not only at the LNP site, but would also be scattered among other locations in the United States or, in the case of foreign-purchased uranium, in other countries.

In addition to fuel-cycle impacts from proposed LNP Units 1 and 2, this cumulative analysis considers fuel-cycle impacts from the existing CREC Unit 3, including the planned extended power uprate of 20 percent. There are no other nuclear power plants within 50 mi of the LNP site. The fuel-cycle impacts of CREC Unit 3 would be less than that of LNP Units 1 and 2. In accordance with 10 CFR 51.51(a), the NRC staff concludes that impacts would be acceptable for the 1000-MW(e) reference reactor. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 would reduce environmental impacts relative to the operating reference reactor. For example, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. In Section 6.1, the NRC staff multiplied the values in Table S–3 by a factor of 2.6, to scale the impacts up from the 1000-MW(e) LWR model to address the fuel cycle impacts of LNP Units 1 and 2. Adding the fuel-cycle impacts from CREC Unit 3 would increase the scaling to no more than a factor of four. Therefore, the NRC staff considers the cumulative fuel-cycle impacts related to LNP Units 1 and 2 to be SMALL, and no further mitigation would be warranted.

7.11.2 Transportation

The description of the affected environment in Section 2.5.2.3 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the LNP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the LNP site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the LNP site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the site. The additional traffic increases the risk of traffic accidents, injuries, and fatalities. A review of the projects listed in Table 7-1 indicates that other projects in the region could potentially increase nonradiological impacts. The most significant cumulative nonradiological impacts in the vicinity of the LNP site would result from major construction projects, including the decommissioning of the fossil fuel units at the CREC, the Inglis Lock bypass channel spillway hydropower project, nearby mining projects, and highway improvement projects.

Cumulative Impacts

The approval by the State of Florida of the LNP requires the decommissioning of two of the four fossil fuel units at the CREC by December 31, 2020, contingent upon completion of the first fuel cycle at LNP Unit 2 and timely licensing and construction of the LNP (FDEP 2010a). Because decommissioning of the fossil fuel units is contingent upon completion of the first fuel cycle at LNP Unit 2, it is unlikely that interactions would occur between construction traffic at the LNP site and traffic from decommissioning activities at the CREC. The Tarmac King Road Limestone Mine likely would begin operations before construction at the LNP site. Bridge construction on US-19 and the FGT pipeline would be completed by fall 2010 and by 2011, respectively, which is before construction would commence at the LNP site. The US-19 expansion from Homosassa Springs to Crystal River would be completed by 2014 and would overlap with LNP construction for 2 years.

The operating facilities with potential for cumulative nonradiological impacts include the CREC with the two remaining fossil fuel units and the Crystal River Nuclear Power Plant, the Inglis Rock Quarry, the Crystal River Mariculture Center, and other aquaculture facilities. Traffic flow to and from operating facilities in the region would be of lesser importance because fewer workers and material shipments are needed to support operating facilities than major construction projects.

The Goethe State Forest and numerous parks, forests, reserves, and recreational areas are within 50 mi of the LNP site. Development is likely limited in these areas and potential park improvements generally are of smaller scope and have lower resource and personnel requirements than construction at a new nuclear power plant. Therefore, park improvements are not likely to result in a measurable cumulative impact.

In Sections 4.8.3 and 5.8.6, the review team concluded that the impacts of transporting construction material and construction and operations personnel to and from the LNP site would be a small fraction of the existing nonradiological impacts in Levy County, Florida. Based on the magnitude of nuclear power plant construction relative to the other construction activities already listed and the potential closure of the two fossil fuel units at the CREC, which would result in less employee traffic and fewer coal deliveries, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed new reactors at the LNP site and other past, present and reasonably forseeable future impacts would be minimal, and no further mitigation would be warranted.

As described in Section 6.2, the NRC staff concludes that impacts of transporting unirradiated fuel to the LNP site and irradiated fuel and radioactive waste from the LNP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the LNP site.

Historically, the radiological impacts on the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the LNP site have been associated with shipments of fuel and waste to and from the existing CREC Unit 3 located about 9 mi from the LNP site. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the LNP site and CREC Unit 3, and fuel fabrication facilities and waste disposal sites located in other parts of the United States. No other major activities with the potential for cumulative radiological impacts were identified in the geographic area of interest. Based on Table S-4 in 10 CFR 51.52, the impacts of transporting unirradiated fuel to CREC Unit 3 and irradiated fuel and radioactive waste from CREC Unit 3 would be minimal. When combined with the impacts of transporting unirradiated fuel to the LNP site and irradiated fuel and radioactive waste from the LNP site, the cumulative impacts of transporting unirradiated fuel to the LNP site and CREC Unit 3 and irradiated fuel and radioactive waste from the LNP site and CREC Unit 3 would also be minimal. The past, present, and reasonably foreseeable impacts in the region surrounding the LNP site are also a small fraction of the impacts from natural background radiation.

Advances in reactor technology and operations since the development of Table S-4 would reduce environmental impacts relative to the values in Table S-4; therefore, the values in Table S-4 remain bounding. For example, improvements in fuel management have been adopted by nuclear power plants to achieve higher performance and reduce fuel requirements. This leads to fewer unirradiated fuel and spent fuel shipments than the 1000-MW(e) reference reactor discussed in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capabilities would result in fewer shipments of spent fuel to offsite storage or disposal facilities. This would reduce the cumulative impacts of transporting unirradiated fuel to the LNP site and CREC Unit 3 and irradiated fuel and radioactive waste from the LNP site and CREC Unit 3.

Therefore, the NRC staff considers the cumulative radiological and nonradiological transportation impacts of operating the proposed new reactors at the LNP site to be SMALL, and no further mitigation would be warranted.

7.11.3 Decommissioning

As discussed in Section 6.3, the environmental impacts from decommissioning the proposed LNP Units 1 and 2 are expected to be SMALL because the licensee would have to comply with decommissioning regulatory requirements.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the LNP site. In addition to proposed Units 1 and 2, the only other nuclear power plant within this geographic area of interest is the existing CREC Unit 3. The impacts of decommissioning nuclear power plants are bounded by the assessment in Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities.* In that document, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be SMALL (NRC 2002). In addition, the NRC staff concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be SMALL. Therefore, the cumulative impacts of decommissioning the LNP site and CREC Unit 3 would be SMALL, and further mitigation would not be warranted.

7.12 Staff Conclusions and Recommendations

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of two nuclear units at the Levy County site together with other past, present, and reasonably foreseeable future actions. The specific resources that could be affected by the incremental effects of the proposed action when considered with other actions listed in Table 7-1 in the same geographic area were assessed. This assessment included the impacts of construction and operation for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed action.

Table 7-4 summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although there could be MODERATE or LARGE impacts for some resources as discussed below.

MODERATE cumulative impacts on land use in the geographic area of interest would result from new transmission lines constructed to connect LNP Units 1 and 2 to the grid and the Tarmac King Road Limestone Mine, in combination with construction, preconstruction and operation of the LNP Units 1 and 2. The incremental impact from NRC-authorized activities on land use would be SMALL because the affects to land use from constructing and operating Units 1 and 2 would be minimal. Cumulative impacts to surface water quality would be MODERATE, primarily due to the combined discharges from the operation of CREC Units 1-5, the proposed uprate at Unit 3, and operations at LNP. The incremental impacts from NRC-authorized activities at LNP would be SMALL.

Cumulative impacts on terrestrial ecological resources would be MODERATE as a result of increased habitat fragmentation, impacts on important species, and loss of wetlands. The incremental impact from NRC-authorized activities would be SMALL to MODERATE, primarily due to the possible effects of groundwater withdrawal on wetlands and associated biota. Although incremental impacts on terrestrial resources could be noticeable near the LNP project, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

Table 7-4. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Units 1 and 2

Resource Category	Impact level
Land-Use	MODERATE
Water-Related	
Water Use – Surface Water	SMALL
Water Use – Groundwater	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	SMALL
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems	SMALL
Socioeconomic	
Physical Impacts	SMALL
Demography	SMALL
Taxes	SMALL (adverse) to LARGE (beneficial)
Economy	SMALL (beneficial)
Housing	SMALL
Transportation	SMALL to MODERATE
Public Services and Education	SMALL to MODERATE
Aesthetics	MODERATE
Recreation	SMALL
Environmental Justice	SMALL
Historic and Cultural Resources	SMALL
Air Quality	SMALL to MODERATE
Nonradiological Health	SMALL
Radiological Health	SMALL
Nonradiological Waste	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

For socioeconomics, the construction of the NRC-authorized increment would result in MODERATE short-term adverse effects on police, emergency service, fire protection, and schools in specific local communities during peak construction and preconstruction employment years. These effects would be expected to become SMALL once local funding has been adjusted after a few years of LNP operation. Cumulative impacts on taxes and economy would be MODERATE to LARGE and beneficial. In Levy County, the cumulative impacts would be

LARGE and beneficial once both Units 1 and 2 are operational. MODERATE adverse impacts to local aesthetics would occur along new transmission-line corridors. MODERATE adverse transportation impacts could also occur during periods in which peak operations of the Tarmac King Road Limestone Mine coincide with shift changes at LNP.

For air quality, the cumulative impacts would be SMALL to MODERATE primarily due to national and world-wide impacts of greenhouse gases emissions. The incremental impacts from NRC-authorized activities would be SMALL because such impacts would be minimal.

7.13 References

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

10 CFR Part 52. Code of Federal Regulations, Title 10 *Energy,* Part 52. "Licenses, Certifications, and Approvals for Nuclear Power Plants."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81 "Designation of Areas for Air Quality Planning Purposes."

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40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

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8.0 Need for Power

Chapter 8 of the U.S. Nuclear Regulatory Commission's (NRC's) NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000) guides the NRC staff's review and analysis of the need for power for a proposed nuclear power plant. The guidance states the following:

> Affected states or regions continue to prepare need-for-power evaluations for proposed energy facilities. The NRC will review the evaluation for the proposed facility and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the State's or region's need-for-power evaluation is found acceptable, no additional independent review by NRC is needed, and the State's analysis can be the basis for ESRPs 8.2 through 8.4 (NRC 2000).

In a 2003 response to a petition for rulemaking (68 FR 55905), the NRC concluded that "…need for power must be addressed in connection with new power plant construction so that the NRC may weigh the likely benefits (e.g., electrical power) against the environmental impacts of constructing and operating a nuclear power reactor." The NRC also stated in its response to the petition discussed above that (1) the NRC does not supplant the States, which have traditionally been responsible for assessing the need for power-generating facilities, their economic feasibility, and regulating rates and services; and (2) the NRC has acknowledged the primacy of State regulatory decisions regarding future energy options (68 FR 55905). Consequently, the review team's role with regard to a need for power review is to identify whether an independently derived needs determination meets the four acceptability criteria, and, if it does, report that independently derived determination's conclusions. No independent assessment of the relevant service area's need for power is necessary or within the scope of the review team's National Environmental Policy Act of 1969, as amended, requirements.

The purpose and need for the Levy Nuclear Plant (LNP) project identified in Section 1.3 is to generate 2200 MW(e) baseload power to meet the need for power within Progress Energy Florida, Inc.'s (PEF's) service territory. In 2008, the State of Florida through its Public Service Commission (FPSC) concluded that by 2016, PEF would need at least as much additional generating capacity as would be available from the proposed LNP Units 1 and 2 to meet its customer's demand and its own reserve margin requirements (FPSC 2008). The following sections discuss the need for power in the context of FPSC's determination.

8.1 Description of the Power System

In Florida, investor-owned utilities such as PEF are regulated by a public service commission and serve a well-defined service territory. The State of Florida, through the FPSC, regulates

PEF rates, electric service and grid reliability, and the planning and implementation of generation and transmission resources to serve loads within the PEF service territory. In the case of the proposed LNP, PEF obtained a "Determination of Need" from the FPSC, based on Final Order PSC-08-0518-FOF-EI and dated August 12, 2008 (FPSC 2008). In its decision, FPSC provides its full reasoning, based on PEF's petition and FPSC's own analysis, for making its determination. For the purposes of this environmental impact statement (EIS), the NRC staff identified FPSC's determination of need as an independently derived needs determination that was (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. Therefore, the review team relied upon that FPSC Determination of Need for the remainder of this section of the EIS.

The remainder of this section characterizes the institutional and physical characteristics of the PEF system, and the review team's basis for relying on FPSC's determination of need. Section 8.1.1 reviews the current power system, including geographic considerations, and regional characteristics. Section 8.1.2 provides an assessment of the FPSC's analytical processes in the context of the Agency's four acceptability criteria. It discusses the specific criteria FPSC used to make its determination. Section 8.2 discusses some of the key factors affecting the demand for electricity and provides a table from the PEF Environmental Report (ER) showing the PEF/FPSC analysis of future demand. Section 8.3 describes the PEF/FPSC assessment of the supply of electricity, projected out to 2017 along with a table from the ER showing the PEF/FPSC analysis of the future supply of electricity. Section 8.4 reports the FPSC's conclusions regarding the determination of the need for power as proposed by the applicant and verified by the FPSC evaluation.

8.1.1 Description of the PEF System

PEF is a wholly-owned subsidiary of Progress Energy, an investor-owned diversified energy company operating power generating 21,000 MW of electrical generating capacity at 32 locations in Florida, North Carolina, and South Carolina. PEF's electrical generating technologies and fuel sources include hydroelectric, nuclear, coal, oil, and natural gas. PEF serves an area of about 20,000 square miles in 35 of 67 Florida counties, including the cities of Orlando, St. Petersburg, and Clearwater (see Figure 8-1 for a map of PEF's service area counties). The Region of Influence (ROI) for the proposed action is this 35 county area.

The ROI is within the Florida Reliability Coordinating Council (FRCC), an administrative sub-region of the North American Electricity Reliability Corporation (NERC). The FRCC includes investor owned utilities, cooperative utilities, municipal utilities, federal power agencies, power marketers and independent power producers and was created to ensure the reliability and adequacy of current and future bulk electricity supply in Florida and the US. The entire FRCC region is within the Eastern Interconnection.

PEF is part of an interconnected power network that enables power exchange between utilities. The PEF transmission system includes 5000 mi of transmission lines in Florida, including about

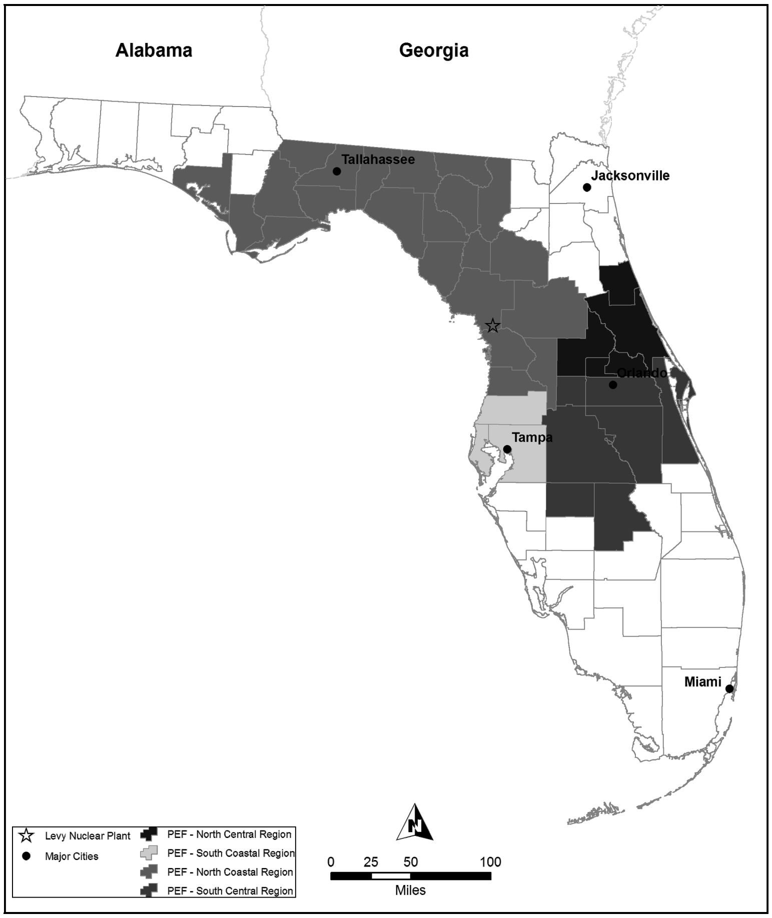

Figure 8-1. The PEF Service Territory (PEF 2009a)

18,000 mi of overhead distribution conductors and 13,000 mi of underground cable (PEF 2009c). As of December 31, 2008, PEF had total summer capacity resources of approximately 11,197 MW, consisting of installed capacity of 9289 MW (excluding Crystal River Unit 3 joint ownership) and 1908 MW of firm purchased power (PEF 2009a).PEF provided electricity service to over 1.6 million customers in Florida in 2006, including retail sales to about 350 communities and wholesale sales to about 21 Florida municipalities, utilities, and power agencies (PEF 2009a). Table 8-1 illustrates recent trends in electricity sales by customer class based on the 2009 Databook (PEF2009b). Although total sales have been relatively stable over the recent past, sales to the wholesale market have increased in share by 50 percent in this period, presenting kilowatt-hour sales growth of greater than 56 percent. In the ER (PEF 2009c), PEF explained that it relies on two measures of reliability in its resource planning. First, a deterministic measure known as “reserve margin” is used to reflect PEF’s ability to meet its forecasted seasonal peak load with firm capacity. The reserve margin is the percentage of a utility’s total available capacity that must be available for service (firm), over and above the

Table 8-1. Shares of Electricity Sales by PEF Customer Class

Customer Class	2003	2004	2005	2006	2007	2008
Residential[(a)]	45.7	44.3	44.8	45.8	44.0	42.8
Commercial[(a)]	27.2	26.9	26.9	27.4	26.9	26.9
Industrial[(a)]	9.4	9.3	9.3	9.5	8.4	8.4
Other[(a)]	7.0	7.0	7.2	7.5	7.4	7.3
Wholesale[(a)]	10.2	11.7	12.3	10.4	13.1	15.0
Unbilled[(a)]	0.5	0.8	−0.5	−0.5	0.2	−0.3
Total (millions of kWh)	42,512	43,653	44,436	43,731	45,300	45,190

Source: PEF 2009b
(a) Percent of PEF customer class

system peak load, as insurance against forced outages and other planned or unplanned events that could cause outages. PEF uses a 20-percent minimum reserve margin criterion in its resource-supply planning.

PEF uses another measure of reliability termed “loss of load probability” that reflects the probability that a company will be unable to meet its load throughout the year. This measure is a utility industry standard reflecting the maximum of 1 day in 10 years loss of load probability. PEF finds that the reserve margin criterion is triggered before the loss of load probability criterion in its resource planning methodology.

8.1.2 Evaluation of the FPSC Analytical Process

In accordance with NUREG-1555 (NRC 2000), the review team found that the analytical process and need for power evaluation performed the FPSC met the four NRC criteria for being (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. The following details how the four NRC criteria were met.

8.1.2.1 Systematic

The review team found that FPSC used a systematic process for determining the need for the LNP project. Regulatory provisions in Florida state that on an annual basis PEF must provide the most up-to-date forecast and expected resource portfolio, respective of all known current conditions. PEF accomplishes this through an iterative process for load forecasting, which is updated and reviewed annually as directed by the State through the FPSC. Load forecasts use utility industry best practices and methodological approaches to determine the utility’s need for power and the most cost-effective strategies to meet its regulatory obligations. In its Determination of Need proceedings, the FPSC staff and other witnesses indicated that PEF’s forecasts were reasonable for planning purposes and that PEF had provided a reliable and appropriate basis for assessing the need for LNP Units 1 and 2. The FPSC opinion is stated below:

> FPSC "reviewed PEF's forecast assumptions, regression models, and the projected system peak demands and find that they are appropriate for use in this docket. The forecast assumptions were drawn from independent sources, which we have relied upon in prior cases. The regression models used to calculate the projected peak demand conform to accepted economic and statistical practices. Finally, although slower customer growth could reduce peak demand, the projected peak demands produced by the models used by PEF appear to be a reasonable extension of historical trends." (FPSC 2008)

Therefore, the regulatory provisions in combination with FPSC's Determination of Need proceedings demonstrate to the review team that a systematic process was applied for determining the need for the LNP project.

8.1.2.2 Comprehensive

The review team finds that FPSC's analysis of issues affecting the need for power in the PEF service territory is comprehensive. The factors analyzed by FPSC include electric system reliability, the need for baseload capacity specifically, the bases for forecasts and cost assumptions and whether viable alternatives exist. PEF's peak demand and energy forecasts incorporate key influencing factors, such as economic and demographic trends, weather, and implemented load-reduction programs such as new energy efficiency and Demand Side Management programs (DSM). Forecasts included each sector of the economy, and separate forecasts were developed to determine both short- and long-term demand. Power-supply forecasts included a comprehensive evaluation of present and planned generating capabilities as well as present and planned power purchases and sales in the service territory. PEF identified all existing generators by fuel type, planned expansions, new construction, and potential closure over the relevant time period, all of which FPSC found reasonable. All analyses are performed with forecasting and statistical modeling and methodological approaches appropriate for the power industry.

8.1.2.2 Subject to Confirmation

The NRC staff found that the process, models, and estimations used in the FPSC Determination of Need are subjected to a rigorous confirmation process by expert witnesses and the general public. These proceedings and relevant findings are all documented in the Final Order issued by the FPSC (FPSC 2008). The FPSC performed an independent analysis of the PEF assertions made in its application and affirmed the forecasting methods and results. The NRC staff reviewed the FPSC conclusions and did not identify any areas where PEF or FPSC remained unconfirmed or contradictory. Also, the NRC staff did not find conflicting conclusions from other independent sources, such as NERC's long-term reliability assessment.

The FPSC review process also takes into account the need for a reliable power system, fuel diversity, dependable supply of electricity, base-load power generating capacity, adequate electricity at reasonable cost, and if the project is the most cost-effective option (FPSC 2008). These factors are outside the authority of the NRC review, but demonstrate the standards of the FPSC Determination of Need review process.

8.1.2.4 Responsive to Forecasting Uncertainty

The review team also finds that the FPSC Determination of Need was based upon a forecasting methodology that incorporated uncertainty by the use of alternative scenario analysis and probabilistic modeling of the electrical system, which are standard industry practices. FPSC relied upon PEF analyses that tested the validity of its overall forecast by analyzing the impact of alternative load forecasts (high, medium, and low). In addition, FPSC quantified uncertainty in the load forecast by evaluating the resource portfolios against variations in future sensitivities, such as fuel and construction costs, load forecasts, environmental laws and regulations, and risk. For example, PEF introduced the potential impact of climate legislation and customer-owned generation, such as photovoltaic systems in manufactured homes, on the project. Also, PEF discussed the potential impact of a reduced demand forecast from poor economic conditions. FPSC deemed these considerations reasonable in their analysis. In doing so, PEF developed resource portfolios that quantify the long-term cost to customers under varying potential sensitivities while understanding the fundamental strengths and weaknesses of various resource configurations.

8.2 Determination of Demand

PEF performs demand forecasts in order to provide continuous service to its regulated service area, meet its contractual commitments to wholesale customers, and to contribute to the reliability of the FRCC region. Forecasts are based on expected growth population and other economic factors. These analyses are contained in PEF's annual Integrated Resource Plan (IRP) and became the basis for PEF's petition to the State of Florida for a Determination of Need for the proposed project. This process is governed by Section 403.519 of the Florida Statutes and by Rule 25-22.080 of Florida Administrative Code. The FPSC reviewed PEF's petition for a Determination of Need, which was submitted on March 11, 2008; and the resulting Final Order granting the petition was issued by the FPSC on August 12, 2008 (FPSC 2008).

8.2.1 Factors in the FPSC Determination of Need

This section discusses key factors affecting the future demand for electricity that FPSC used for the issuance of its Determination of Need Final Order. The FPSC provides an independent review of the PEF forecasts and other assertions to draw its own conclusions regarding the PEF case that a need exists for both proposed units at the LNP site. Each section below describes a specific factor FPSC considered in granting its Determination of Need.

8.2.1.1 Growth in Demand

The principal factor affecting the change in demand for electricity over time is the change in the number and type of customers needing that power. Electrical demand and energy usage in Florida are unique because residential customers make up the largest part of the customer base--comprising over 88 percent of Florida's electricity customers and consuming 53 percent of the state's total generating capacity. In developing their annual IRPs, PEF used population projections produced by the Florida Bureau of Economic and Business Research at the University of Florida to estimate growth in their customer base. PEF also applied standard State and national economic assumptions on growth that were produced by the independent group *Economy.Com* for Florida forecasts. PEF also projected growth in the demand for electricity based upon demand sectors. PEF determined that Florida has grown recently by about a third of a million new residents each year and by about a third of a million jobs. Consequently, PEF anticipates future growth of about 1.8 percent per year on average between the present and 2017. This is lower than the historic 2.2 percent growth rate of the last ten years, which is indicative of slower population growth, based on the latest projection from the University of Florida's Bureau of Economic and Business Research, and less favorable economic conditions.

Florida's industrial demand for electricity amounts to about 11 percent of the total generating capacity in the state. For industrial demand, PEF identified four major customers that accounted for 28 percent of the industrial demand in 2007—all in the phosphate mining sector, which produces agricultural fertilizers. The supply and demand for agricultural products are a function of, among other factors, foreign competition, global agricultural industry conditions, international finance factors, and foreign trade. Industrial load and energy consumption at the PEF-served mining or chemical processing sites depend heavily on plant operations, which are heavily influenced by these global as well as other local conditions. PEF estimates that, barring any major unforeseen contractions in industry (reductions in production or closures of plants), that industry-related energy consumption would increase in the near term, as a new mine operation is expected to open. A significant risk to this projection lies in the volatile price of energy (i.e., natural gas), which is a major cost of both mining and producing phosphoric fertilizers (PEF 2009a).

8.2.1.2 Electric System Reliability

One of the most important functions of an electrical generating unit is to contribute to the protection of the overall electricity distribution system by producing more electricity than its service area demands. This is done as a hedge against unforeseen emergencies that could disrupt the delivery of electricity. This excess production is commonly called a "reserve margin," and PEF applies a 20 percent reserve margin to all of its demand projections (PEF 2009a). FPSC reviewed PEF's assertion that without the proposed action, PEF would be unable to maintain its minimum reserve margin planning requirement beginning in 2016. FPSC found no issue with PEF forecast assumptions, regression models, and projected system peak demands provided for this petition and affirmed PEF's reliance on the 20-percent reserve margin. Table 8-2 presents PEF's reserve margin analysis (PEF 2009a).

Table 8-2. PEF Reserve Margin Forecast by Case

	PEF Reserve Margin (percent)[(a)]		
Year	**Without LNP Units 1 and 2**	**With LNP Unit 1**	**With LNP Units 1 and 2**
2015	23.0	23.0	23.0
2016	15.4	25.3	25.3
2017	13.4	23.2	33.0
2018	11.5	21.2	30.8
2019	9.7	19.1	28.6
2020	7.9	17.2	26.5
2021	6.2	15.4	24.6

Source: PEF 2009b
(a) PEF's targeted reserve margin equals 20 percent.

Expert witnesses testified to the FPSC that while reserve margins would climb to 33 percent in 2017, they would return to about 20 percent by 2023 under the proposed action. As a result, the FPSC found PEF had demonstrated that new capacity will be needed by 2016 to maintain its 20-percent reserve margin and the proposed action would satisfy PEF's capacity needs through 2023 (FPSC 2008).

8.2.1.3 Demand Side Management and Energy Efficiency

DSM and energy efficiency (EE) measures for the production of electricity are a significant factor in the growth of electricity demand. PEF described an active DSM program in its 2008 Ten Year Site Plan and included it in its IRP and petition for a Determination of Need to the FPSC. According to PEF, about 389,000 customers participated in the Energy Management program by the end of 2007 and succeeded in reducing the demand for electricity by about 760,500 kW of winter demand; about 273,000 customers participated to reduce summer demand by about 290,000 kW. Other PEF energy efficiency programs include: aggressive customer education programs, home energy audits, financial incentives, rate incentives, and commercial reduction strategies. Through their energy-efficiency programs, PEF customers have saved more than $750 million in energy costs over the last 25 years, roughly equivalent to the electricity demand of Orlando for two years (about 10 billion kWh) (PEF 2009a).

8.2.2 PEF's Demand for Electricity

This section reproduces the expected demand for electricity (Table 8-3) developed by PEF for its petition for a Determination of Need and ER Chapter 8, Need For Power. These data became the basis for the FPSC's 2009 issuance of a Determination of Need upon which the review team relied for this section of the EIS.

Table 8-3. PEF's Expected Demand for Electricity 2008 - 2017

Year	Additions		Subtractions		Net Firm Demand
	Wholesale	Retail	DSM and EE	Other	
2008	1343	9304	1113	110	9424
2009	1191	9551	1166	125	9451
2010	1265	9762	1213	125	9689
2011	1282	9990	1274	125	9873
2012	1439	10,220	1339	125	10,195
2013	1464	10,449	1394	125	10,393
2014	1463	10,670	1440	125	10,568
2015	1475	10,886	1460	125	10,776
2016	1491	11,087	1492	125	10,961
2017	1510	11,287	1522	125	11,150

Source: PEF 2009a

8.3 Determination of Supply

FPSC reported in its Determination of Need, that as of June 2006, PEF's generation capacity profile in Florida was approximately as follows: 43 percent coal generated, 30 percent natural gas generated, and 14 percent nuclear. The other 13 percent is a mixture of purchased power from alternative fuels (such as solar, hydro, wood waste, solid waste, and biomass), and oil generated plants (FPSC 2008).

For its power supply and capacity forecasts, PEF considered its present and planned generating capabilities (including planed uprates, closures of facilities, and additional new power generation facilities), present and planned purchases of power from generators outside the service region, and its sales of power to consumers outside the service region. In its analysis of potential competitors to the proposed project, PEF also considered other projects, market purchases, and customer-owned generation, including power from renewable energy sources, especially photovoltaic systems.

FPSC used PEF's 2016 supply of electricity forecast, which is 13,736 MW without Levy 1 and 2. PEF believes that by 2016, it will need 509 MW to meet its 20 percent reserve margin target. By 2017 (the projected start of operation for Levy 2; Levy 1 is projected to begin operation in 2016), PEF determined (and FPSC concurred) that the 2200 MW generated by the proposed project would increase PEF's reserve margin to 33 percent. PEF estimates this would satisfy its reserve margin requirements until about 2023 (FPSC 2008). Table 8-4 below shows the installed and forecasted installed capacity from 2009-2017.

Table 8-4. Forecasted Installed Capacity at Summer Peak (MW)

Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total Installed Capacity[(a)]	9859	9890	9900	10035	11065	11065	11065	11961	13053
Firm Capacity Import[(b)]	1467	1592	1680	1989	1879	1748	1748	1336	1336
Firm Capacity Export	0	0	0	0	0	0	0	0	0
Qualifying Facilities	173	173	323	439	439	439	439	439	439
Total Capacity Available[(c)]	11499	11655	11903	12463	13383	13252	13252	13736	14828

Source: PEF 2009c

(a) Total installed capacity does not include the 143 MW to Southern Company from Intercession City.

(b) FIRM capacity import includes cogeneration, utility and independent power producers, and short-term purchase contracts.

(c) 2016 total capacity includes Levy 1 coming online. 2017 total capacity indicates Levy 2 also coming online.

8.4 Conclusions

The review team finds that the FPSC Determination of Need process was rigorous, subject to public review and oversight, and should lend great weight to the NRC's conclusions. In its determination, FPSC made projections to 2016 that indicate there is a need for at least an additional 2200 MW(e) of baseload electricity generation to meet system needs and to provide for an adequate reserve margin. Because their review process met the NRC's four criteria for reliability, the review team finds no reason to challenge the PSNC conclusions.

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10. SUPPLEMENTARY NOTES

Docket Nos. 52-029, 52-030

11. ABSTRACT *(200 words or less)*

This environmental impact statement (EIS) has been prepared in response to an application submitted by Progress Energy Florida (PEF) to the U.S. Nuclear Regulatory Commission (NRC) for combined licenses (COLs) for Units 1 and 2 at the proposed Levy Nuclear Plant site in Levy County, Florida. This EIS includes the review team's analysis that considers and weighs the environmental impacts of the proposed action and mitigation measures for reducing and avoiding adverse impacts

The NRC staff's preliminary recommendation to the Commission, considering the environmental aspects of the proposed action, is that the COLs be issued. The recommendation is based on (1) the COL application; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in PEF's Environmental Report and this EIS.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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